

20-1025 (Lead); 20-1138 (Consolidated)

**UNITED STATES COURT OF APPEALS
FOR THE DISTRICT OF COLUMBIA CIRCUIT**

ENVIRONMENTAL HEALTH TRUST; CONSUMERS FOR SAFE CELL
PHONES; ELIZABETH BARRIS; THEODORA SCARATO

CHILDREN'S HEALTH DEFENSE; MICHELE HERTZ; PETRA BROKKEN;
DR. DAVID O. CARPENTER; DR. PAUL DART; DR. TORIL H. JELTER; DR.
ANN LEE; VIRGINIA FARVER, JENNIFER BARAN; PAUL STANLEY, M.Ed.

Petitioners

v.

FEDERAL COMMUNICATIONS COMMISSION;
UNITED STATES OF AMERICA

Respondents

Petition for Review of Order Issued by the
Federal Communications Commission

DEFERRED JOINT APPENDIX**VOLUME 11**

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Dr. Paul Dart MD. (Petitioner), Comments, Sep. 1, 2013

Paul Dart MD FCA
3495 Harris Street
Eugene, OR 97405
September 1, 2013

Federal Communications Commission

r.e. Comments on Notice of Inquiry, ET Docket No. 13-84

Dear Sirs,

I am part of a medical advisory group that has spent the last 18 months researching the current medical literature on the biological or “non-thermal” effects of microwave radio frequency transmissions, in an effort to assist the Eugene Water and Electric Board in making prudent decisions on their choices of technology as they consider installing an AMI infrastructure of RF-transmitting “smart” electric meters. This document contains the product of our efforts—an extensive written review of the research to date on biological effects of RF.

Also attached to this filing are five pdf documents from an audiovisual presentation on this subject, illustrating research evidence for adverse effects including EHS (electrohypersensitivity syndrome), alterations in hormone physiology, DNA damage, cancer, infertility, and increased brain tumor risk from cell phones.

The FCC has not chosen to implement any safety standards regarding non-thermal effects of microwave RF exposure. But the existing literature demonstrates that there is significant cause for concern regarding the growing impacts of these exposures on the public. Research documenting their adverse biologic and health effects is robust now. The implications of this research cannot be discounted, and must not be ignored.

The FCC should request that the EPA impanel a Working Group composed of health experts who have no conflicts of interest with industry to review the scientific literature on EMR. The Group should recommend biologically-based EMR standards that ensure adequate protection for the general public and occupational health based upon the precautionary principle. Finally, the FCC should adopt the standards, testing procedures, and appropriate precautionary warning language recommended by the Working Group.

It would be indefensible at this time for the FCC to take any actions that may increase exposure of the population to EMR from cell phones, base stations, Wi-Fi, Smart Meters and other RF or ELF-emitting devices. The current levels of exposure need to be reduced rather than increased further. The FCC must especially protect vulnerable groups in the population including children and teenagers, pregnant women, men of reproductive age, individuals with compromised immune systems, seniors, and workers.

Sincerely yours,

Paul Dart MD FCA

**BIOLOGICAL AND HEALTH EFFECTS OF
MICROWAVE RADIO FREQUENCY
TRANSMISSIONS**

A REVIEW OF THE RESEARCH LITERATURE

**A REPORT TO THE STAFF AND DIRECTORS OF
THE EUGENE WATER AND ELECTRIC BOARD**

June 4, 2013

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EXECUTIVE SUMMARY

The FCC regulations for permissible exposures to microwave radio frequency (RF) transmissions are only designed to protect against the thermal effects of high exposure levels. Representatives of the telecommunications industry usually assert that there is “no clear or conclusive” scientific evidence regarding the biological effects of low level or “nonthermal” RF exposures. But in actuality, a large body of scientific research documents that RF exposures at low levels can produce adverse biological or health effects.

The installation of RF-transmitting “smart meters” by our electric utility could significantly increase the level of RF exposure in Eugene’s residential neighborhoods. Such an increase carries potential health risks. The nature of these risks needs to be carefully considered before making a decision to deploy this technology.

Any decision-making process that ignores this possibility of harm could cause significantly damage both to community health and to EWEB’s goodwill in the community.

ELECTROHYPERSENSITIVITY (EHS)

Microwave RF exposures can produce acute symptoms in some individuals. These symptoms can include headache, sleep disturbance, difficulty in concentration, memory disturbance, fatigue, depression, irritability, dizziness, malaise, tinnitus, burning and flushed skin, digestive disturbance, tremor, and cardiac irregularities. This syndrome was described by Russian researchers in the 1950’s, who called it “microwave sickness”. Between 1953 and 1978 the Russian government purposefully targeted the U.S. embassy in Moscow with beams of microwave RF, producing symptoms of microwave sickness in many embassy employees.

In recent years, the buildout of the wireless telecommunications infrastructure has greatly increased the exposure of the general public to microwave RF, and this has led to an increased number of individuals experiencing symptoms that are now referred to as “Electrohypersensitivity Syndrome” (EHS). Multiple research studies have shown a correlation between these symptoms and residential exposure to radio, radar, and cell tower transmissions.

The prevalence of EHS appears to be increasing, as the exposure of the public to RF continues to expand. Based on recent epidemiologic research, it would be reasonable to assume RF exposures provoke some sort of symptoms in between 3 and 5% of the population of Eugene at the current time. Any significant increase in residential RF exposure is likely to make these individuals more symptomatic, and to produce some new cases of EHS by pushing some other individuals beyond their tolerance limit.

ALTERED PHYSIOLOGY

Laboratory research in animal and human subjects has shown that “nonthermal” levels of RF exposure can alter EEG, immune function, and hormone levels including adrenal and thyroid hormones, testosterone, prolactin, progesterone.

Research shows that low levels of microwave RF exposure can reduce melatonin levels in humans, and that some individuals are more sensitive than others to this effect. The adverse effects of nighttime RF exposure on melatonin secretion are particularly disturbing. The nocturnal rise in melatonin levels supports the natural function of sleep, and disrupting this cycle can produce insomnia. Melatonin is an extremely potent antioxidant, and helps to repair damaged DNA and heal the body from other

EXECUTIVE SUMMARY

effects of oxidant stress.

Melatonin is also protective against the growth of cancer cells, and disruption of the circadian melatonin cycle has been shown to lead to increased tumor growth in a variety of cancer types. Women who have lower levels of nocturnal melatonin are at greater risk for developing breast cancer. Reduced melatonin levels may also increase the incidence of prostate cancer.

OXIDATIVE STRESS AND DAMAGED DNA

In contrast with Xrays and gamma rays, Microwave radiation does not have sufficient power to directly break covalent bonds in DNA molecules. But microwave RF can produce resonance interactions with ions and with charged macromolecules, and such interactions can significantly alter biochemical functions. A large body of research has shown that microwave RF causes an increased production of free radicals and reactive oxidant species in living tissues, and that this increased oxidant stress damages DNA. This damage can and does occur at power levels well below those levels that could produce damage by thermal mechanisms.

Any chronic exposure to conditions that damage DNA can lead to an increased risk of cancer. Evidence of increased risk of certain types of cancer has been demonstrated in groups with occupational exposure to microwave RF, including radio technicians in private industry, military personnel, commercial airline pilots, and ham radio operators. Elevated levels of cancer have been demonstrated in populations with increased residential exposure to radio transmission towers. And in the last ten years, studies from Israel, Germany, Austria, and Brazil have documented significant increased in breast cancer and other cancers in individuals living less than 500 meters from cell phone towers, with measured exposure levels much lower than those permitted by current FCC guidelines.

Research has also shown that RF exposure levels well within current guidelines can cause DNA damage and reduced fertility in insects, birds, amphibians and mammals, and can lower sperm counts, sperm motility, and sperm motility in human beings.

RISKS OF CELL PHONE USE

Cell phone use expanded dramatically in Europe and the United States in the late 1990's. Early studies of the cancer risks of cell phone use were hampered by short latency periods of exposure. In general, studies funded by industry have reported lower levels of risk than independently funded studies. But in the last four years, all but the most poorly designed studies have shown an increased risk of brain tumors with more than ten years of use—a level of exposure which appears to double the risk of brain tumor on the side of the head where the cell phone is customarily held. This risk is higher in those who started using cell phones as children.

CONCLUSIONS

Existing scientific research offers strong evidence that the chronic exposure of the public to microwave RF transmissions produces serious acute and chronic health effects in a significant portion of the population. These findings can be summarized in the following precepts:

EXECUTIVE SUMMARY**Basic Precepts for Residential Exposures to RF Transmissions:**

- Excessive RF exposure can cause acute problems (headaches, insomnia, fatigue, vertigo, tinnitus, other symptoms of EHS).
- Excessive RF exposure can also cause chronic problems (oxidative stress, cancer, male infertility).
- Constant RF transmission is probably harmful, even at low levels, and should be avoided.
- Frequent and repetitive intermittent transmissions are also probably harmful, and should be avoided.
- Nocturnal exposures are more problematic than daytime exposures, because of RF's potential to suppress nocturnal melatonin secretion and disturb sleep, and because night is the time when we rest and heal from stresses (including oxidative stress).
- Occasional and infrequent daytime exposures are much less likely to cause an increase in chronic problems for the population at large.
- Occasional and infrequent daytime exposures are still likely to provoke acute symptoms in a small percentage of the population.

EWEB should adopt a policy of minimizing their RF footprint in the community.

A recognition of these precepts should lead EWEB to adopting a policy of minimizing their infrastructure's RF footprint in the community as much as possible during regular operations. This doesn't mean that staff would throw away their cell phones and communicate by semaphore. But it would mean that instead of combatting or ignoring the possibility that more RF in the community could cause harm, EWEB should acknowledge the potential risks of excessive residential exposure.

This would mean that such potential risks would be seriously considered in any discussion of the total risks and benefits involved (the "Total Bottom Line"), as EWEB decides *whether* to use RF technology for any given purpose. If, after such a discussion, a considered decision is made to use RF technology, then these same potential risks should be taken into serious consideration in determining *how* to use this technology in a manner that would minimize potential harm to the community.

In other words, don't use RF when you don't have to. Use hard-wired connections wherever it is feasible to do so. And if you do use RF, design the infrastructure in a way that uses as little of it as possible.

In the final section of this report, we discuss the perspectives that such a policy might bring to a consideration of the available AMI technologies.

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PREFACE

This paper represents the efforts of a group of physicians who have been in private practice in Eugene for decades. Our concerns are for the health of our patients as well as for our community as a whole.

When EWEB proposed installing a “mesh” smart meter network we became concerned. We know that there are people in this community who are highly sensitive to electromagnetic fields. The installation of the smart meter mesh would make Eugene a much more hostile environment for these individuals.

We also know that chronic exposures to microwave radio frequency (RF) transmissions can produce adverse long term physiological effects, even in individuals who do not consciously experience acute symptoms from exposure to such electromagnetic fields.

As we considered these issues, we were not sure if the policy makers at EWEB had sufficient current and applicable scientific information upon which to rely, as they evaluated the potential health effects of such an implementation. EWEB may have referred to FCC guidelines, without considering that the FCC regulations on radio frequency (RF) exposure are only designed to protect against the thermal effects of extremely high level RF exposures, and do not attempt to define a safe level of protection against other biological effects.

Because of these concerns, we have undertaken a sixteen month long investigation of the scientific literature, in order to present what we feel is a valid scientific basis for evaluating the potential health effects of a community-wide RF smart meter installation. This paper presents our findings to you.

We have organized this report into six sections:

1. An introduction into some of the issues involved in the “smart meter” Advanced Metering Infrastructure.
2. A review of the scientific research documenting the existence of acute reactions to “non-thermal” levels of RF exposure -- reactions which in their most severe form are called electrohypersensitivity syndrome (EHS).
3. A review of the function of melatonin, of evidence that RF exposure can suppress melatonin, and of the short and long term consequences of melatonin suppression.
4. A review of the long term effects of RF exposure, especially the production of oxidative stress that can lead to DNA damage and increased levels of cancer and infertility.
5. A review of current research regarding relationship of cellular and cordless telephone use to increased risk of brain tumors.
6. A discussion of our conclusions and recommendations to EWEB, based on this review of the scientific literature.

INTRODUCTION

AMI and the Smart Energy Grid

The Advanced Metering Infrastructure (AMI) technology is a key component of the smart energy grid that we heard discussed in very general terms in the 2008 presidential election. During the past two years, EWEB has been actively exploring the possibility of installing AMI in Eugene.

EWEB staff have described several purposes for going to an AMI “smart meter” infrastructure, including the following:

Reducing operating costs

Remote reading of meters would eliminate meter readers, allowing EWEB to save substantial costs in employee time and benefits, vehicle use, and gasoline costs. Smart meters can also be used to turn power on and off remotely, saving labor and travel costs when rentals become vacant or occupied.

Shifting time of use

Smart meters can measure and record total power usage for several intervals during the day. This will allow EWEB to bill customers more for electrical usage at peak use hours, typically the early morning (when people are getting up, taking showers, cooking breakfast) and late afternoon/early evening (when people return home from work, cook dinner, take showers, throw some clothes in the laundry, etc.). Time of use billing could create an incentive for customers to shift elective usage (laundry, recharging the electric car) away from peak usage hours.

Electrical utilities need enough generating capacity to meet peak demand. Reducing or restraining the growth of peak usage could reduce or slow the need to build more power generating capacity into the system.

Training customers to conserve electricity

Smart meter technology can allow home owners to monitor their usage in real time over a home network with the meter. EWEB hopes that this direct feedback will encourage people to reduce their energy consumption.

“Demand/Response” infrastructure

EWEB has invested a great deal in wind power. But the wind tends to blow hardest in the middle of the day and the middle of the night. At dawn and dusk (peak usage times for electrical consumers) the wind is more likely to calm down.

This creates a storage problem for the utility. When wind power production is high during the night, production can exceed demand, generating more electricity than can be used locally or sold interstate.

One way to distribute and store this energy is to put it in your water heater. Two way communication with your Smart Meter could allow the power company to turn your water heater on for 15 minutes in the middle of the night or the middle of the day, at a time when it would otherwise not be on [they can’t turn it on for two hours, when it gets to the maximum heat setting the thermostat will turn it off]. EWEB would seek customers willing to volunteer to allow this arrangement.

With “demand/response” control, EWEB could store excess wind power as heat by turn on clusters of water heaters for 15 minutes, then turn them off and turn on other clusters of water heaters, and continue to rotate the usage around the community during the middle of the night.

SECTION 1 – INTRODUCTION

Solar power generation creates another storage problem. Solar panel output can fluctuate rapidly during the day with changing cloud cover. Too sudden an increase in local production from multiple large panels could overload the grid. The AMI infrastructure would allow the utility to tell Smart Meters to turn off solar panel input into the electrical grid. Again, this requires rapid two-way communication between the utility and the Smart Meter, and between the Smart Meter and the solar panel in the house.

From an engineering point of view, the simplest and cheapest way to install this communications infrastructure is to have the meters communicate with the utility and with the “smart appliances” in the home using *wireless microwave radio technology*.

The use of this wireless technology for AMI communications has generated a good deal of political heat in the last two or three years. To understand where this heat has come from, it is instructive to review the history of the Pacific Gas and Electric Company’s smart meter rollout in California.

PG&E in California, 2010 – 2011

In 2010 and 2011 PG&E rolled out an AMI infrastructure in multiple cities in California. The metering technology that they chose to install was the Silver Springs AMI “smart meter”. These meters communicate with the utility by forming a “mesh” network in the neighborhood. The meters communicate with each other rather than with a central receiver, and pass data through this MESH network to the central collecting system of the electric utility.

The installation of such technology places a radio transmitter on every house in the community. Concerns about the potential health effects of this residential RF exposure led several members of the California Assembly to request that the California Council on Science and Technology (CCST) perform a study of whether current FCC standards for Smart Meters were sufficiently protective of the public health, and whether additional standards might be needed for such technology.

It should be noted that the regulatory standards established by the Federal Communications Commission are based on defining safe levels against the thermal effects of microwave radio frequency (RF) exposure (i.e. “Will it cook you?”) For example, the FCC has established Limits for Maximum Permissible Exposure (MPE). (FCC, 1999, page 15). The FCC has explicitly stated that they do not make any regulations or assurances whatsoever regarding the “nonthermal” biological effects of microwave exposure (other physiologic effect besides heat damage). (Hankin, 2002)

The CCST released a report on “Health Impacts of Radio Frequency from Smart Meters” in January, 2011. (CCST, 2011) This report stated (on page 5) that Smart Metering technology met the FCC standards for “safety against *known thermally* induced health impacts”. It also stated (on page 4) that “*To date, scientific studies have not identified or confirmed negative health effects from potential non-thermal impacts of RF emissions such as those produced by existing common household electronic devices and smart meters. Not enough is currently known about potential non-thermal impacts of radio frequency emissions to identify or recommend additional standards for such impacts.*” The CCST report concluded that “*There is no evidence that additional standards are needed to protect the public from smart meters.*” (page 26)

When the Draft Version of this CCST report was released, several experts in the field of research that studies the biological effects of RF communicated their disagree-

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ment with the study's conclusions. It was pointed out that the content of the CCST document was in major part a repetition of a document produced by the industry-sponsored Electric Power Research Institute a few weeks before (Tell, 2010), and that the analysis of AMI smart meter exposure levels in the report was incorrect in its design. (Hirsch, 2011)

These experts offered evidence of multiple scientific studies documenting the nonthermal health impacts of RF. (Sage, 2011b) (Johansson, 2011) Independent research was presented to the CCST documenting that the Silver Springs meters produced levels of household exposures significantly higher than levels shown to have adverse health effects in current scientific research. (Sage, 2011a)

These objections from the scientific community did not alter the CCST's stance on smart meters, which continued to be installed in California.

What happened next in California

PG&E's approach to the AMI rollout didn't involve a lot of public education. They just switched out the meters. And some people found that they were having trouble sleeping, or experiencing headaches, ringing in the ears, vertigo, or other symptoms that hadn't been bothering them before. Soon the internet was awash in anecdotal reports and commentary about these adverse effects. (emfsafetynetwork.org, 2011)

PG&E's public posture was that the meters only transmitted for an average of 45 seconds per day. They asserted that the total power output over time was well below the FCC guidelines for thermal risk, and well below that of other RF exposures in the community. Videos began to crop up on You Tube showing that the picture wasn't that simple (for example, <http://www.youtube.com/user/thisirradiatedlife/featured>).

Finally PG&E was served with a court order to provide clear documentation of what the meters actually were doing. (Yip-Kikugawa, 2011) In the response to that court order, PG&E provided documentation from the manufacturer of the meters that the *average* meter in the mesh network transmitted data signals to the utility 6 times a day, network management signals 15 times a day, timing signals 360 times a day, and beacon signals to the mesh network 9,600 times a day. (Kim et al., 2011) This penciled out to an average of roughly 7 transmissions a minute, 24 hours a day, coming out of every meter in the community.

As reports of provoked symptoms increased, the situation became more and more politically heated. Santa Cruz County banned the installation of smart meters. PG&E continued to install them, and the Santa Cruz County Sheriff's office refused to enforce the ban. Individuals started purchasing refurbished analogue electric meters and swapping them out themselves, attempting to return the smart meters to the utility. PG&E publicly stated (a week or two before Christmas) that they would turn off the power of anyone who removed a smart meter from their service box—but backed down from that threat due to public backlash.

By the end of 2011, multiple cities in California had either banned smart meters or placed a moratorium on their continued installation, and a lawsuit has been filed against PG&E with the California Public Utilities Commission. (Wilner, 2011)

EWEB's Elster MESH AMI Trial

In 2010 EWEB set up a trial of AMI infrastructure, using the Elster REX2 Smart Meter. Like the Silver Springs meter used by PG&E in California, the REX2 operates on a mesh network. The meters upload usage data to a central collection meter 4 to 6 times

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a day, but transmit short beacon signals to the network several times a minute.

EWEB stated on their website that these meters transmit “less than 10 seconds a day”. But they were unable to state how frequently transmissions actually occurred. In our communications with their public relations staff, we were told that Elster was unwilling to release this information. Information on the power output of these meters is available on the ELSTER website. (TUV Rheinland, 2010) But Elster does not discuss the actual frequency of transmission of the meters.

In January 2012 we used a Gigahertz Solutions HF35C analyzer to evaluate the output of one of these Elster meters in a residential neighborhood in Eugene.

Background RF signals coming through the neighborhood were measured in a 360 degree circle around the monitoring position. The background RF averaged around 4 microwatts/square meter ($\mu\text{W}/\text{m}^2$), increasing to 8 or 10 $\mu\text{W}/\text{m}^2$ when we aimed our directional antenna at the radio towers on Blanton Heights or at a distant cell phone tower.

The Elster meter’s transmission rate was variable. In our observations, they are definitely transmitting several times a minute, sometimes 4 or 5 times a minute, and occasionally in bursts of significantly higher frequency.

At 5 feet from the smart meter, the peak strength of the beacon signal coming off the meter measured from 3800 to 11,000 $\mu\text{W}/\text{m}^2$. At 20 feet from the meter, the power density of the signal ranged from 362 to 493 $\mu\text{W}/\text{m}^2$, with occasional bursts at higher power output.

This means that at a distance of 20 feet the power of the signal coming out of the Elster meter was *about 100 times* the power of the ambient background signal coming from any specific direction in the residential neighborhood.

This power density of 300+ to 400+ $\mu\text{W}/\text{m}^2$ was greater than the signal strength of the cell phone tower at 29th and Amazon, measured from about 200 meters away. So filling a neighborhood with a mesh network of the Elster smart meters would be similar to placing every house in that neighborhood closer than 200 meters from a cell phone tower, each house constantly being pinged by the chatter of multiple beacon signals from the mesh.

This was disconcerting, since recent research has shown that people living within 500 meters of a cell phone tower have increased incidence of headache, concentration difficulties, and sleep disorders, and also a significantly increased risk of some types of cancer. (Khurana et al., 2010) (Levitt and Lai, 2010) (Yakymenko et al., 2011) (Altpeter et al., 2006) (Abdel-Rassoul et al., 2007)

When you put these facts together, it is not so surprising that the installation of mesh smart meter networks in residential neighborhoods in California last year was followed by a surge of anecdotal evidence regarding headaches, insomnia and other health complaints. From a medical perspective, based on a familiarity with current research on the biological effects of RF, this was a predictable consequence of PG&E’s smart meter MESH network rollout.

Formation of our Advisory Committee

By late 2011 EWEB staff were working towards setting a specific timeline for installing AMI in Eugene. From our perspective, the potential health risks of such a project did not appear to have received any realistic discussion. EWEB’s web site implied that such risks were inconsequential. In January of 2012 EWEB’s Public Rela-

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tions staff started to test a public relations campaign promoting the AMI project. Their initial presentation minimized the possibility any health risks from this exposure.

Some physician members of our group became involved in discussions with EWEB staff. In these discussions, we tried to learn more about the technologies under consideration from EWEB engineers, and in turn we attempted to communicate our concerns about the potential health risks of this technology.

It became clear to us that EWEB staff did not have the time or the expertise to research this issue of health risks in any depth. Our sense of this was confirmed in April of 2012, when EWEB management presented the AMI Business Case to the EWEB Board. The discussion of “Potential Health Risks” in this document quoted government agency reports as if they were scientific studies, and stated that in an *“attempt to discover if there were any credible studies showing any health effect caused by long-term RF exposure in relatively high dosages (e.g. exposures much greater than an AMI meter) . . . no conclusive evidence was found that indicates that this higher magnitude RF exposure has created adverse health impacts.”*

EWEB is a locally owned utility with a lot of goodwill in the community. We were concerned that if EWEB continued forward without taking a deeper look at this issue, decisions might be made that would have the potential to cause significant harm to the health of the community, or to create political strife that could significantly damage EWEB’s local standing.

In an effort to help EWEB think this problem through in a more complete and considered fashion, we decided to form a group of physicians and other professionals with scientific and engineering expertise. Over the past 16 months, our group has studied the scientific literature on the biological effects of microwave RF. This report is the result of our efforts.

We hope that EWEB’s staff and Board will examine this information carefully, and that it will help them to make prudent choices as they consider the various AMI technologies that are currently available to them.

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ELECTROHYPERSENSITIVITY

"MICROWAVE SICKNESS"

Acute symptoms provoked by microwave radiation were first described by Russian medical researchers in the 1950's. They described a constellation of symptoms including headache, ocular dysfunction, fatigue, dizziness, sleep disorders, dermatographism, cardiovascular abnormalities, depression, irritability, and memory impairment. (Liakouris, 1998)

In the years between 1953 and 1978 the Russian government harrassed the U.S. Embassy in Moscow by targeting it with radiation from a microwave transmitter. Concern about health effects led to a detailed study by A.M. Lilienfeld, an epidemiologist at Johns Hopkins University. (Lilienfeld AM, 1979)

The abnormalities found in this study were an embarrassment to the U.S. government, since the levels of exposure experienced by embassy staff were in the order of 2 to 28 microwatts/cm², a level dramatically below the described U.S. safety standards for microwave exposure. The conclusions of the study were altered to soft-pedal any abnormal findings. (Goldsmith, 1995b) (Cherry, 2000)

But outside epidemiologic analysis of the Lilienfeld report's published data showed that exposed embassy staff experienced a statistically significant excess of several problems, including depression, irritability, difficulty in concentrating, memory loss, ear problems, skin problems, vascular problems, and other health problems. Symptom incidence increased significantly with accrued years of exposure. (Goldsmith, 1995a) (Cherry, 2000)

THE EMERGENCE OF "ELECTROHYPERSENSITIVITY" AS A DIAGNOSIS

In recent years the buildout of cellular communication networks has created a markedly increased exposure of the public to RF transmissions. Each new generation of cell phone technology has occupied a higher frequency on the microwave scale, with potentially increasing impact on body physiology. (Cherry, 2002) As this has occurred, mounting evidence has pointed to the fact that a percentage of the population experiences adverse reactions associated with these exposures. The term "electrohypersensitivity" (EHS) has been used to describe a constellation of symptoms, including headache, sleep disturbance, difficulty in concentration, memory disturbance, fatigue, depression, irritability, dizziness, malaise, tinnitus, burning and flushed skin, digestive disturbance, tremor, and cardiac irregularities. Sleep disturbance, headache, nervous distress, fatigue, and concentration difficulties are the most commonly described symptoms. (Roosli et al., 2004)

These symptoms are identical to the symptoms of "microwave sickness" described by Russian physicians in the 1950's.

SYMPTOMS PROVOKED BY TRANSMISSION TOWERS

In 2002, Santini reported significant increases in such symptoms in individuals living closer than 300 meters to cell towers. (Santini et al., 2002) (Santini R, 2003)

In Poland, Bortkiewicz found similar increases in symptoms among residents near cell towers. Symptoms showed equal association to proximity of the tower, regardless of whether or not the subject suspected such a causal association. (Bortkiewicz et al., 2004) (Bortkiewicz et al., 2012)

In two studies, Abelin and Altpeter found evidence of disruption of sleep cycle

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and melatonin physiology by RF transmission during the operation and subsequent shutdown of the short wave radio transmitter in Schwarzenburg, Switzerland. (Abelin et al., 2005) (Altpeter et al., 2006)

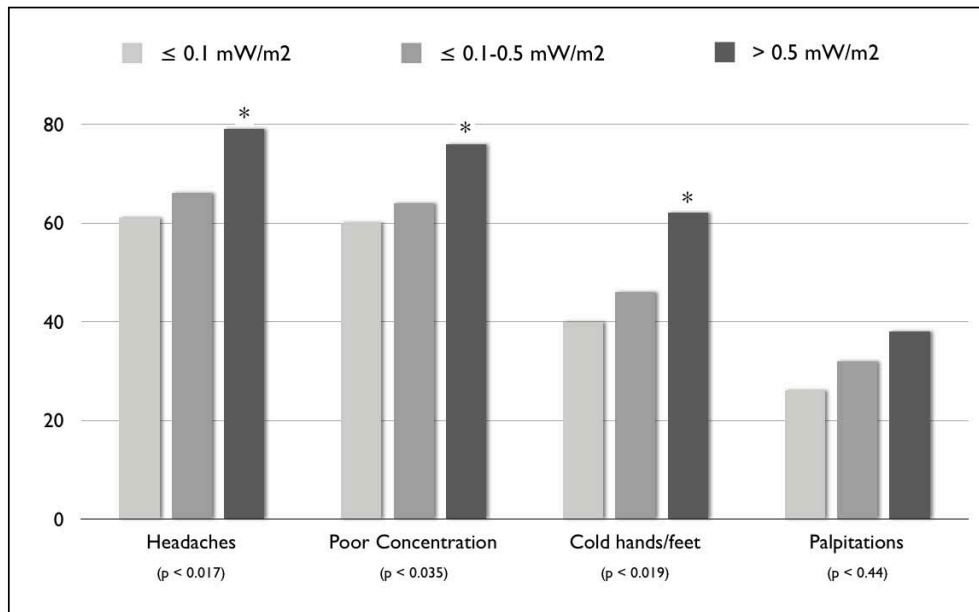


Figure 1: Percentage of subjects reporting symptoms, stratified by RF exposure levels as measured in subject's bedroom. (Hutter et al., 2006)

In a study done in urban and rural sites in Austria, Hutter found a clearly significant correlation between exposed signal power density and headaches and concentration difficulties—despite the fact that maximum measured power densities were only 4.1 mW/m^2 ($= 0.41 \text{ } \mu\text{W/cm}^2$, well below established “safe” limits). (Hutter et al., 2006)

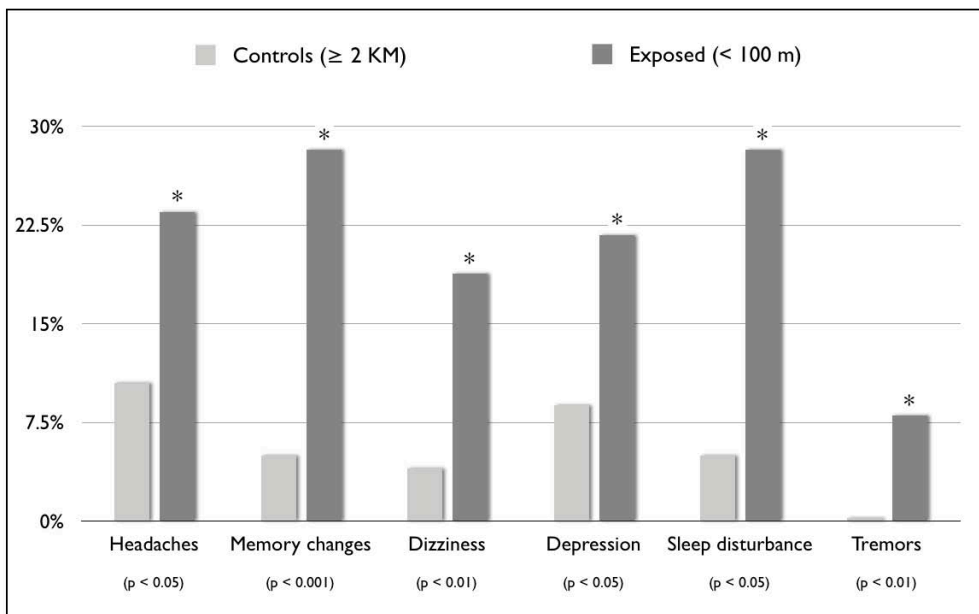


Figure 2: Percentage of subjects reporting symptoms, stratified by proximity to city's first cell phone tower. (Abdel-Rassoul et al., 2007)

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In Egypt, a study of inhabitants living near the first cell phone tower in the city of Shebeen El-Kom found a significant increase in headaches, memory changes, dizziness, tremors, depressive symptoms, and sleep disturbance, with lower performance on tests of attention and short-term auditory memory. (Abdel-Rassoul et al., 2007)

Research at the military radar installation in Akrotiri, Cyprus, showed that residents of exposed villages had markedly increased incidence of migraine, headache, dizziness, and depression, and significant increases in asthma, heart problems, and other respiratory problems. (Preece et al., 2007)

Studies in Murcia, Spain yielded similar findings, and based on measured exposures the authors suggested that safe levels of indoor exposure should not exceed $1 \mu\text{W}/\text{m}^2$ ($0.0001 \mu\text{W}/\text{cm}^2$) (Navarro et al., 2003) (Oberfeld et al., 2004)

In a study of residents of Selbitz, Bavaria, researchers found statistically significant increases in multiple health symptoms that demonstrated a dose-response relationship with cell phone tower transmissions. Individuals living within 400 meters of the cell phone tower had significantly more symptoms than those living > 400 meters from the tower. And individuals living within 200 meters of the tower had significantly higher symptoms than those living between 200 and 400 meters from the tower. (Eger and Jahn, 2010)

Two recent reviews provide a detailed overview of research in this area. (Khurana et al., 2010) (Levitt and Lai, 2010)

SYMPTOMS PROVOKED BY CELL PHONE USE

Multiple studies of cell phone users in the last decade found evidence of a similar pattern of symptoms to be provoked in some users. (Chia et al., 2000) (Ofstedal et al., 2000) (Santini R, 2002) (Wilén et al., 2003) (Salama and Abou El Naga, 2004) (Al-Khlaiwi and Meo, 2004) (Balikci et al., 2005) (Balik et al., 2005) (Szyjowska et al., 2005) (Meo and Al-Drees, 2005) (Soderqvist et al., 2008) (Landgrebe et al., 2009) (Hutter et al., 2010)

PHYSIOLOGY OF ELECTROHYPERSENSITIVITY

A variety of research models have demonstrated that RF exposure does not have a uniform effect on people. In many studies, a cohort of individuals has been identified that has a more sensitive response to RF in one way or another.

Reduced heart rate variability

In one study, patients with symptoms consistent with EHS were found to have decreased circadian changes in heart rate variability. (Lyskov et al., 2001) Similar changes in HRV were found in another study where subjects self-identified as having EHS symptoms from exposure to video display terminals, TV screens, fluorescent lights, or other electrical equipment. (Sandstrom et al., 2003) An occupational study of RF plastic sealer workers also found alterations in heart rate compared to normal controls.

Fatigue and reduced melatonin

In the more recent Schwarzenberg study, the effect of RF exposure on producing morning fatigue and reduced melatonin secretion was significantly greater in the subjects whose general quality of sleep was below the median. (Altpeter et al., 2006)

SECTION 2 – ELECTROHYPERSENSITIVITY**EEG changes**

Alterations in EEG have been found in animals and in people with exposure to both magnetic fields and cell phone transmission frequencies. (Marino et al., 2003) (Marino et al., 2004)

Nanou et al found the EEG response to be gender dependent after exposure both to 900 MHz and 1800 MHz signals. (Nanou et al., 2005) (Nanou et al., 2009)

Bachman found EEG changes with 450 MHz microwave exposure in 25 to 30% of healthy volunteers (Bachmann et al., 2005) (Bachmann et al., 2006). In another study, EEG changes were 5 times as common in depressive subjects as in healthy controls. (Bachmann et al., 2007)

Landgrebe found decreased intracortical excitability in EEG after transcranial magnetic stimulation in self-identified EHS patients, as compared with normal controls. (Landgrebe et al., 2007)

Schmidt found alteration in sleep EEG after exposure to a 900 MHz RF signal modulated at two different frequencies, and noted a marked individual variation in sensitivity to this effect. (Schmid et al., 2011)

Loughran found alterations in non-REM EEG after cell phone RF exposure. These alterations were consistently stronger in one subset of his study group, over multiple tests. (Loughran et al., 2012)

Altered Immune Function

Exposure to both GSM and UMTS cellular transmissions at nonthermal exposure levels have been shown to alter DNA repair mechanisms in lymphocytes. (Markova et al., 2005) (Belyaev et al., 2009) Multiple additional studies have demonstrated non-thermal biological effects of RF radiation on immune cell function, as reviewed here. (Johansson, 2007) (Johansson, 2009b)

One of the most intriguing findings is Johansson's research showing that patients with electrosensitivity have higher levels of mast cells in their skin, and that these mast cells migrate closer to the skin surface. (Johansson, 2006) Mast cells are responsible for the itching, burning, and skin flushing that occurs after sunburn exposure. The presence of higher levels of mast cells in EHS patients provides an explanation for the symptoms of flushed, itching, and burning skin on the face and other areas that is described by these patients, who appear to be reacting to RF exposure like others might react to excessive sun exposure. Since mast cells are distributed throughout the body, the presence of mastocytosis in EHS patients may relate to some other symptoms as well.

Hormonal Changes

Chronic exposures to electromagnetic field effects have also been shown to cause alterations in secretion of multiple hormones. A study published in 2007 showed that physiotherapists working with various electromagnetic treatment modalities had significantly elevated secretion levels of the stress hormones cortisol, adrenaline, and noradrenaline. (Vangelova et al., 2007)

Another study measured urinary secretion of the stress hormones adrenaline and noradrenaline, along with levels of dopamine and phenylethylamine, prior to and over the 1 1/2 years following the installation of a GSM cell phone tower in Rimbach, Bavaria. Levels of adrenaline and noradrenaline showed a significant increase over the first six months after exposure, and never returned to baseline levels. Responses

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showed a proportional relationship to residential exposure levels, and were clearly present at levels as low as 60 to 100 microwatts/m² (= 0.006 to 0.010 μ W/cm²). This suggested a chronic stress effect of the GSM microwave signal on the population. (Buchner K, 2011)

Chronic adrenal stress will in time lead to decompensation and symptoms of adrenal fatigue in a certain percentage of the population.

A recently published study evaluated human hormone profiles over six years of exposure to the microwave RF emissions of GSM cell phones or cell phone towers. Findings included highly significant decreases in ACTH, cortisol, both T4 and T3 thyroid hormones. In male subjects, serum testosterone levels gradually decreased with increased time of exposure. In females, alterations in serum prolactin and progesterone levels gradually increased over increased time of exposure. (Eskander et al., 2012)

Current Research

One of us had the opportunity this spring to visit the practice of Dr. Dominique Belpomme, Professor of Oncology at Paris Descartes University, who is conducting research on electrohypersensitivity with the Association for Research and Treatments Against Cancer (ARTAC) in Paris. The ARTAC group has been following several hundred patients with EHS over the last four years, and has documented that these patients have clear and consistent changes in oxidative metabolism, and also in blood flow to the limbic system (as measured by doppler studies). Dr. Belpomme considers these changes in the limbic system to directly correlate with many of the cognitive changes (memory problems, difficulty with concentration, etc.) that are experienced by these patients. The ARTAC group expects to publish a series of papers on their findings during the next year. (Dart, 2012)

PROVOCATION STUDIES

Over the last ten years, many attempts have been made to evaluate the nature of electrohypersensitivity through provocation studies. The limitations of these studies have been discussed in detail in some recent papers. (Loughran et al., 2012) (Regel and Achermann, 2011)

Problems of methodology that have compromised many provocation studies include:

- Many studies have been performed single-blind rather than double-blind.
- Many studies divide the study group and normal controls based on the individual's self-identification as having (or not having) electrohypersensitivity. Since it is certainly possible for people to have reactions to EMF without being aware of this connection, and since the entire population is exposed to EMF at this point in time, it is difficult to be sure that the "control" group is indeed composed of "non-reactors". This will tend to weaken the power of any study set up in this fashion.
- Many studies evaluate whether or not the subject can discern when the RF signal is present and when it is absent. Absence of the ability to make this judgement is taken as evidence that electrohypersensitivity does not exist. This is an extremely illogical assumption. A person can develop a headache during or after an RF exposure without knowing when the signal is "on" or "off", just as they can develop bacterial gastroenteritis without knowing what food was contaminated with the bacteria. Having symptoms from RF and being a reli-

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able RF meter are not the same thing.

- Unspecified or inadequate control of background levels of RF/EMF is also a problem with some “negative” studies. For example, one recent study (Kim et al., 2008) was performed with background RF levels in the study area of 0.5, 0.7, and 0.8 V/m from three different mobile phone service providers. This adds up to a reported 2.0 V/m of background RF, equivalent to several thousand microwatts/m², which is well above threshold levels reported to cause symptoms in many sensitive individuals.
- Many studies assume that all patients who complain of EHS will react to any constant RF signal, and that they will react to it every time. Yet some studies have demonstrated that patients vary in which frequencies they respond to, and that patients can react more strongly to the starting and stopping of a signal than they do to the presence of a steady signal.
- Furthermore, the assumption is often made that EHS symptoms will start when a signal is turned on, and stop when it turns off. These assumptions are problematic, since many patients with EHS report having symptoms that continue for a significant time (hours, in many cases) after a triggering exposure. Few studies discuss whether or not an adequate “washout time” was provided for before starting the study, or between provocation challenges. The absence of such washout times seriously weakens the power of these studies.

In order to do a reliable RF provocation study with EHS exposure, it is necessary to isolate the subjects from background RF levels, and to maintain them in this isolation for long enough that they stop reacting to any prior exposures which they have received, before attempting to provoke a new reaction.

Some studies that are designed to address all these methodologic issues have found clear evidence of electrosensitivity. For example, a study done in 1991 that was performed in an isolated EMF environment tested EHS patients with a variety of different frequencies of RF stimulus, to determine their individual reactivity spectrum. 100 patients who identified themselves as having electrohypersensitivity were tested single blind with a variety of RF frequencies. 25 of these 100 patients showed an increase in symptoms of 20% over baseline, with no more than one placebo response.

These 25 patients were retested in a double blind setting with 25 healthy controls. 16 of the 25 patients (64%) reacted to the positive challenges, which were performed at a variety of frequencies.

These 16 patients reacted to 53% of the 336 active challenges, and 7.5% of the 60 blanks. No patient reacted to all tested frequencies. The 25 healthy controls had no reactions to challenges or to blanks.

Finally, these 16 patients were again tested in a double blind setting, each patient challenged with the single frequency to which they were most sensitive. In this phase of the study, the patients reacted 100% of the time to the active transmissions (with both reported symptoms and autonomic changes on iriscorder) and did not report reactions to the sham transmissions. (Rea et al., 1991)

It must be reiterated that having an adverse reaction to a provoking RF signal and having the ability to determine when the signal is “on” and when it is “off” are two completely different things. A recent double blind study demonstrated that a patient can have consistent provocation of symptoms from a signal without having any clear awareness of when the signal is actually present. (McCarty et al., 2011)

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These provocation studies involve short term exposures to the RF signal (typically an hour or less). Since a great deal of the physiology research shows a more powerful effect with chronic exposures, these short-term studies are probably not the most effective way to assess the clinical significance of reactions to RF.

PREVALENCE OF EHS

Research in Stockholm County, Sweden in 1997 found that 1.5% of the population reported being hypersensitive to electrical or magnetic fields. (Hillert et al., 2002)

In California in 1998, Levallois et al found that 3.2% of the adult population reported being sensitive to sources of EMF. (Levallois et al., 2002)

In Switzerland in 2004, researchers studying a representative sample of the Swiss population found that 5% of the population had symptoms attributable to EHS, with sleep disorders and headaches being the most common reported symptoms. (Schreier et al., 2006)

In Austria in 2004, 2% of the population was estimated to have electrohypersensitivity. In a survey performed in Austria in 2008, 29.3% of respondents reported having some sort of adverse response to electromagnetic pollution. Of this cohort, 2.1% reported intense disturbance, and 3.5% had experienced enough difficulty that they had consulted a physician about the problem. (Schrottner and Leitgeb, 2008)

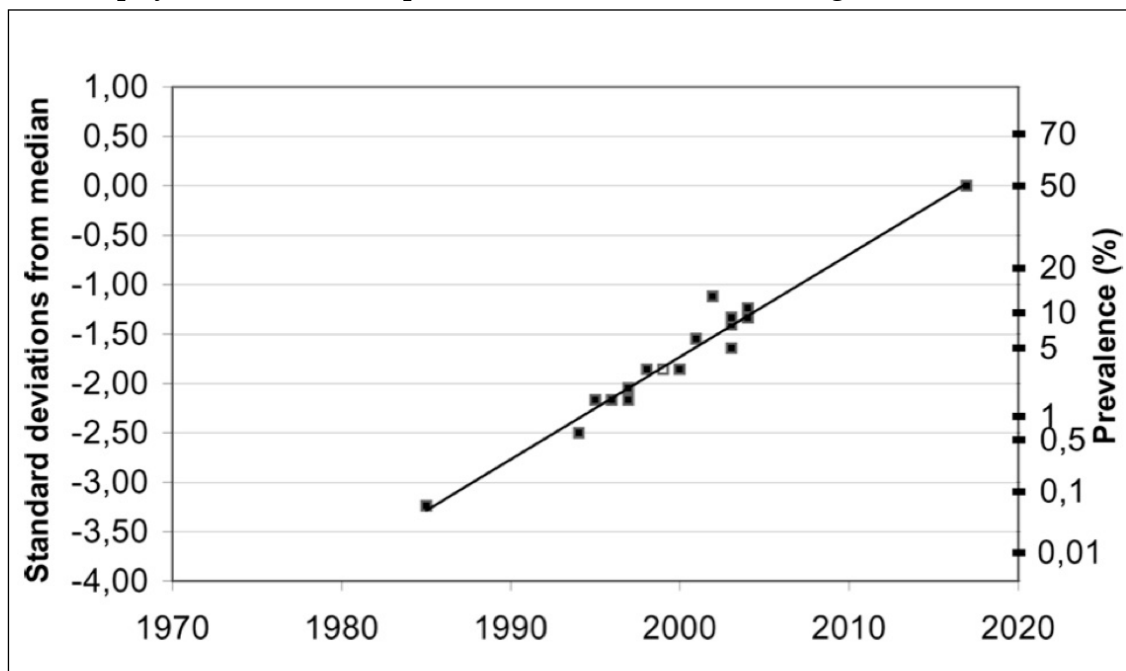


Figure 3: The prevalence of electrohypersensitivity syndrome is increasing.
(Hallberg and Oberfeld, 2006)

In much of the world, exposure to microwave radio signals has continued to significantly increase since the early 1990's. Reported electrosensitivity also appears to be increasing over time. In 2006, Halberg and Oberfeld reviewed research on this subject from 1985 forward, and estimated that if the trend in increased prevalence continues, fifty percent of the population could be reporting adverse effects from EMF by the year 2017 (Figure 1). (Hallberg and Oberfeld, 2006)

SECTION 2 – ELECTROHYPERSENSITIVITY**GOVERNMENTAL RESPONSE**

The various forms of research described above have provided strong support for the fact that RF/EMF exposures can produce symptoms in human beings and that there is a percentage of the population that is more sensitive to this effect. Continued research is suggesting that this is not a static situation—that the prevalence of electrohypersensitivity is a growing over time.

By the middle of the last decade, various government agencies were attempting to define the scope of the problem. (Irvine, 2005)

The rollout of mobile phone technology occurred earlier in scandinavia than in other places in the world, and governmental recognition of EHS as a health problem occurred earlier there than in other places. By the year 2000, EHS was recognized as a disability by the Swedish government. (Ministers, 2000)

In Stockholm, individuals with EHS can receive municipal support to reduce the presence of and penetration of EMF/RF into their homes. The construction of a village with houses specifically designed to mitigate this problem is being considered. Patients with EHS have the legal right to receive mitigations in their workplace, and some hospitals have build low EMF hospital rooms for use by such patients. (Johansson, 2006)

Various government reports or reviews on the question of electrohypersensitivity have been commissioned in the last few years. (Aringer et al., 1997) (Irvine, 2005) And legislation to address the problem has been proposed in some countries. (Snoy, 2011) (Parliamentary Assembly, 2011) Many libraries and schools in europe have banned WiFi due to concerns about health effects on employees and on the public.

REGULATORY RESPONSE

Regulations on exposure limits vary dramatically from country to country. In general, exposure limits have been mandated at a lower level in Russia and eastern Europe, where research on the health effects of RF exposure has been performed for a longer period of time. (Repacholi et al., 2012)

The regulatory standards established by the FCC and the World Health Organization are based on defining safe levels against the thermal effects of RF (i.e. damage from being cooked by high levels of microwave exposure). The FCC has not established exposure standards for potential nonthermal or biological effects of microwave exposure. (Hankin, 2002)

For example, the FCC has established Limits for Maximum Permissible Exposure (MPE). For the general population, the permissible level of exposure at 900 MHz is 600 $\mu\text{W}/\text{cm}^2$, and at 1800 MHz is 1000 $\mu\text{W}/\text{cm}^2$. (FCC, 1999) These exposure levels were last updated in 1996, and are considered to be protective against thermal effects of microwave radiation. However, current scientific research shows that these permissible levles of exposure are hundreds of times higher than the threshold levels for adverse “nonthermal” biological effects.

For the past ten years, the WHO has consistently equivocated on the issue of recognizing nonthermal biological effects from microwave RF exposure, despite the mounting research evidence of health problems and health risks produced by current levels of public exposure.

SECTION 2 – ELECTROHYPERSENSITIVITY

The following table shows exposure standards for various countries in 2001. (Firstenberg, 2001)

Country	($\mu\text{W}/\text{cm}^2$)
New South Wales, Australia	0.001
Salzburg, Austria (for pulsed transmissions)	0.1
Russia	2–10
Bulgaria	2–10
Hungary	2–10
Switzerland	2–10
China	7–10
Italy	10
Auckland, New Zealand	50
Australia	200
New Zealand	200–1000
Japan	200–1000
Germany	200–1000
United States	200–1000
Canada	200–1000
United Kingdom	1000–10,000

Figure 2: RF exposure limits (2001)

PHYSICIAN AND RESEARCHER RESPONSE

In response to this inaction on the part of government and international regulatory bodies over the past decade, a variety of groups of physicians and researchers in the field of RF/EMF health effects have called for regulatory action to address the documented biological consequences of the increasing exposure of the public to RF transmissions.

In 2000, the Salzburg Resolution suggested a total high frequency radiation limit of $100 \text{ mW}/\text{m}^2$ ($10 \mu\text{W}/\text{cm}^2$), and a total emission level of pulse modulated exposure (such as GSM) of $1 \text{ mW}/\text{m}^2$ ($0.1 \mu\text{W}/\text{cm}^2$). (Altpeter et al., 2000)

In 2002 a group of German physicians described a growing problem with adverse clinical effects from RF/EMF, and called for stricter safety limits on RF transmissions, restrictions on cell phone use by children and adolescents, and a ban on cellular and cordless phone use in preschools, schools, hospitals, nursing homes, event halls, public buildings, and vehicles. (2002)

Multiple similar appeals have been made by research groups and medical associations over the past ten years. (Association, 2004) (Leitgeb et al., 2005) (Association, 2012) (Dean A, 2012) (Johansson, 2011) (Johansson, 2009a) (Fragopoulou et al., 2010) (Israel et al., 2011)

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RADIOFREQUENCY EFFECTS ON MELATONIN

THE FUNCTION OF MELATONIN

Many physiologic functions in the human body are entrained in a circadian rhythm, fluctuating through the day/night cycle. The hormone melatonin, secreted by the pineal gland, is a key agent in coordinating these physiologic responses throughout the body. (Zawilska et al., 2009)

The entrainment of melatonin secretion with the day/night cycle is maintained by the suprachiasmatic nucleus in the hypothalamus, which receives input on the presence of light from the retina via the retinohypothalamic tract. In the presence of ambient light, melatonin secretion is suppressed. In the absence of ambient light, melatonin secretion increases. So melatonin secretion is high during the nighttime hours, peaking shortly after midnight. Higher melatonin levels are part of what makes us feel “sleepy” at night. Exposure to light during the nighttime hours will lead to a rapid suppression of melatonin secretion by the pineal gland, and this can cause disruption of sleep and derangement of the circadian rhythm.

Since the length of the day varies seasonally, melatonin also provides our physiology with information and influence produced by the different seasons of the year. This seasonal influence was obviously more profound prior to the widespread introduction of artificial electric lighting.

The circadian rhythm of high nocturnal melatonin levels supports the natural function of sleep, and disruption of this rhythm by bright light at night, night shift work, or travel to different time zones can produce sleep disturbances.

Melatonin is one of the most potent antioxidant molecules in the human body, and acts to reduce reactive oxidative processes in the body. Melatonin can quench the damaging free radical activity produced by inflammation. The presence of elevated melatonin at night is therefore a key factor in the healing and rejuvenating functions that we associate with “a good night’s sleep”.

Many body processes (serum cortisol levels, body temperature, patterns of digestive function, etc.) have a circadian rhythm that is coordinated by the timing signal of melatonin secretion. Melatonin has a protective effect on the health of the gastrointestinal tract. Melatonin is also protective against the growth of cancer cells, and disruption of the circadian melatonin cycle has been shown to lead to increased tumor growth in a variety of cancer types. (Reiter et al., 2011)

Research has clearly demonstrated that melatonin inhibits the proliferation, invasiveness, and metastasis of human breast cancer cells. Women who have lower levels of nocturnal melatonin are at greater risk for developing breast cancer. (Schernhammer et al., 2008) (Schernhammer and Hankinson, 2009) Breast cancer is more common in industrialized societies, and geographically the incidence of breast cancer is strongly associated with higher levels of “light-at-night”. (Kloog et al., 2008) (Kloog et al., 2010)

Current research suggests that disruption of nocturnal melatonin signals by “light at night” can promote both the development and the growth of breast cancer. (Hill et al., 2011) (Stevens, 2009) In 2007 the International Agency for Research on Cancer declared night shift work to be a probable carcinogen. Subsequent epidemiologic research continues to support this finding. (Bonde et al., 2012)

Recent research has also suggested similar associations between “light at night” and the incidence of prostate cancer. (Kloog et al., 2009)

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ELECTROMAGNETIC AND RADIOFREQUENCY EXPOSURES CAN REDUCE MELATONIN PRODUCTION IN THE PINEAL GLAND

In the 1990's, the Swiss government conducted a series of studies of sleep quality near the Swiss national short wave radio transmission tower in Schwarzenburg. These studies were initiated after the government received a petition stating that many residents living near the transmitter were experiencing problems including nervousness, headache, sleep disturbance, and fatigue.

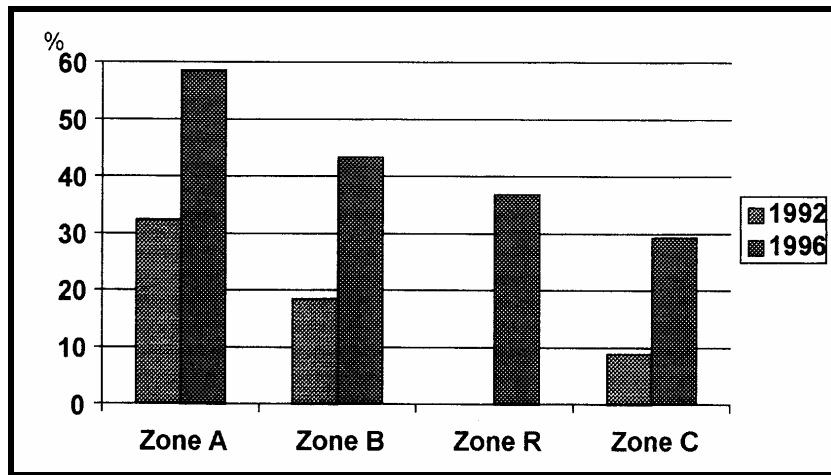


Figure 1: Sleep Disturbance by Proximity Zone in the Schwarzenburg Study. (Cherry, 2002)

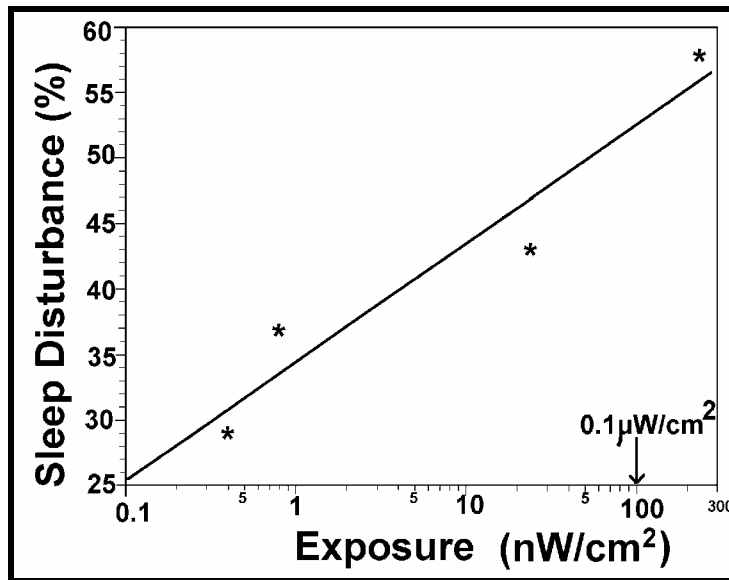


Figure 2: Sleep Disturbance by Exposure Levels in the Schwarzenburg Study. (Cherry, 2002)

In these studies, a statistically significant increase in sleep disturbance was found in residents living closer to the towers. Difficulty in maintaining sleep correlated with transmission field strength, at exposure levels as low as 0.1 nanowatts/cm². (Cherry, 2002) (Abelin et al., 2005)

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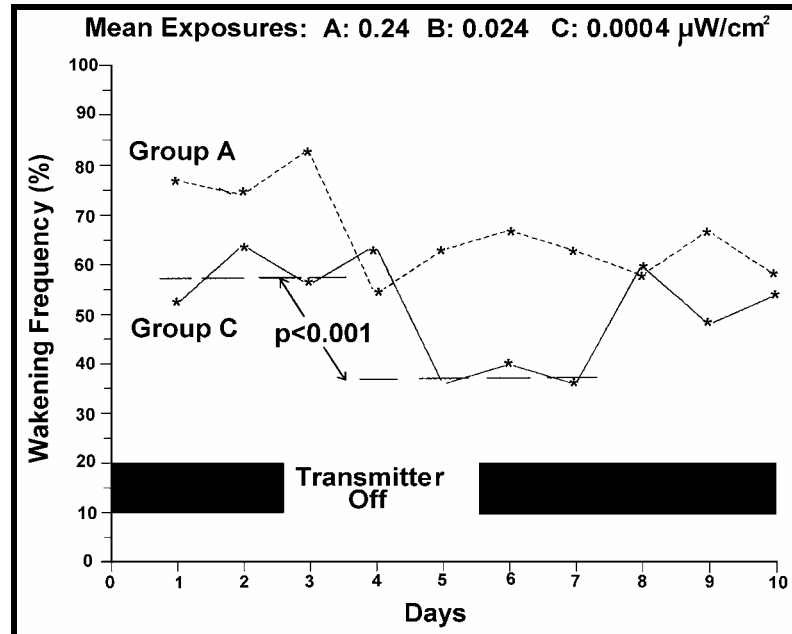


Figure 3: Reduction in Sleep Disturbance with Interruption of Tower Transmission in the Schwarzenburg Study. (Cherry, 2002)

During an interval when the transmitter was turned off for three days, statistically significant reductions in sleep disturbance were found in both the high and the low exposure groups (Figure 3). Note that Group C showed a reduction in sleep disturbance with absence of the signal, despite the fact that signal strength in Zone C averaged only $0.0004 \mu\text{W}/\text{cm}^2$ ($4 \mu\text{W}/\text{m}^2$).

The Schwarzenburg transmission tower was shut down permanently in 1998. In a final research project, sleep quality and salivary melatonin levels were measured in a group of 54 community residents for an interval before and after the end of radio transmission.

Baseline sleep quality was assessed by analysis of sleep diary records, and subjects were stratified into two groups classified as either “poor” or “good” sleepers. Salivary melatonin samples were collected before breakfast, lunch, tea, dinner, and before bed. Subjects recorded morning tiredness and sleep quality, time of falling asleep, and duration of sleep. Exposure levels were calculated for each subjects home.

During the baseline exposure period, scores of morning tiredness directly correlated with increased levels of exposure, and melatonin excretion levels were reduced by a factor of 0.90 for each mA/m of increase magnetic field exposure level. Peak melatonin excretion times were delayed by 4.4 minutes for every $1 \text{ mA}/\text{m}$ increase in exposure level.

After shutdown of the transmitter, subjects’ morning fatigue scores improved by 1.74 units for each $1 \text{ mA}/\text{m}$ of reduced exposure, and melatonin excretion levels increased by a factor of 1.15 per mA/m of reduced exposure. (Altpeter et al., 2006)

The Schwarzenburg shutdown study’s findings were remarkable for two additional reasons. First, there were no other significant levels of short wave radio exposure in the community at the time of the study. So this study provides a true elimination and challenge test of RF exposure effects on a fairly large group of people in their normal environment. Such a study setting was difficult to arrange at that time, and

SECTION 3 – MICROWAVE RF EFFECTS ON MELATONIN SECRETION

would be even more difficult to achieve today, as the number of sources of RF exposure in our communities have increased markedly with the rollout of the wireless telecommunications infrastructure.

Second, the stratification of the study group into “poor” and “good” sleepers allowed recognition of an important additional finding. Improvements in sleep quality and melatonin secretion levels after transmitter shutdown were significantly greater in “poor” sleepers than they were in “good” sleepers. This evidence supports the hypothesis that some individuals may be more sensitive to the effects of microwave exposure, a condition that has been called “electrohypersensitivity” or EHS.

Multiple additional studies in a variety of settings have demonstrated an effect of various forms of EMF/RF on melatonin physiology. Several comprehensive reviews of this research have been published in the last few years. (Cherry, 2002) (Davinipour and Sobel, 2007) (Davanipour and Sobel, 2009)

Performing large long-term studies of RF effects on humans in a sleep laboratory setting would be prohibitively difficult both logistically and financially. But several recent laboratory studies in animals have demonstrated suppression of melatonin by prolonged pulsed microwave RF exposures.

Kesari et al. exposed Wistar rats to 2.45 GHz mobile phone transmissions, 2 hours daily for 45 days, at a calculated SAR of 0.9 W/Kg. Pineal melatonin levels were significantly reduced in exposed animals. (Kesari et al., 2011)

Kumar et al. repeated this experiment with 2.5 GHz exposures of 2 hours per day for 60 days, at a much lower exposure level (power density of 0.21 mW/cm², calculated SAR of 0.014 W/kg). Even at this low level of exposure (= 210 mW/cm²), serum melatonin levels were significantly reduced in exposed animals. (Kumar et al., 2011)

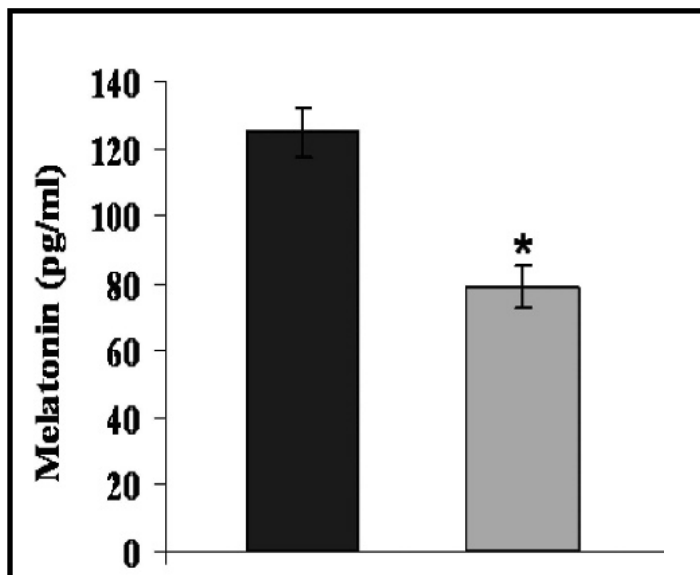


Figure 4: Serum melatonin levels in sham (black) and exposed (grey) Wistar rats after 2 hours daily exposure for 60 days to 2.45 GHz RF transmission at 0.21 milliwatts/cm². (from Kumar et al., 2011)

In another study, Kesari found significant reduction in pineal melatonin levels in rats exposed to 2.45 GHz mobile phone transmissions, 2 hours daily for 45 days, at a power density of 0.21 mW/cm² (calculated SAR of 0.014 W/kg). (Kesari et al., 2012)

SECTION 3 – MICROWAVE RF EFFECTS ON MELATONIN SECRETION**CONSEQUENCES OF REDUCTION OF MELATONIN LEVELS BY MICROWAVE RF EXPOSURE**

Reduction of melatonin levels by exposure to radio transmissions could be expected to cause sleep disturbance. Research findings like the Schwarzenburg studies strongly support this conclusion.

But melatonin has also been found to be protective against promotion of some types of cancer. If suppression of melatonin by “light at night” and night shift work can increase risk of breast cancer (as discussed above), then suppression of melatonin by radio transmissions could also be expected to increase cancer risk. Recently published research studies strongly support this conclusion.

A study in Israel found women living within 350 meters of a cell phone tower to have over 10 times greater risk of cancer than the community as a whole ($p < 0.0001$). (Wolf and Wolf, 2004)

A study of cancer patients in Germany found a 3.29 times greater risk of cancer ($p < 0.01$) in patients with residence closer than 400 meters to a cell phone tower. Risk of breast cancer was 3.4 times greater, and average age of diagnosis of breast cancer was 19 years earlier. (Eger et al., 2004)

In a case/control study of cancer patients residing near a cell phone transmission tower in Austria, those with external residential exposures of greater than $1000 \mu\text{W}/\text{m}^2$ ($> 0.1 \mu\text{W}/\text{cm}^2$) had a breast cancer risk that was 23 times higher ($p = 0.0007$) and brain tumor risk was 121 times higher ($p = 0.001$) than controls. (Oberfeld, 2008)

A recent study from Brazil found a clearly elevated relative risk of cancer mortality at residential distances of 500 meters or less from cell phone transmission towers. (Dode et al., 2011)

Several recent published reviews discuss the multiple epidemiologic studies that have shown an association between residential RF exposure from microwave transmission towers and increased breast cancer risk. (Cherry, 2005) (Khurana et al., 2010) (Levitt and Lai, 2010) (Yakymenko et al., 2011) We will discuss this issue more thoroughly in Section 3.

RAISING THE LEVEL OF RADIOFREQUENCY TRANSMISSION IN RESIDENTIAL NEIGHBORHOODS CARRIES SIGNIFICANT RISKS

Unlike visible light, microwave radio transmissions penetrate walls and human bodies. They are not easily blocked out by window blinds or eye shades. If microwave radio waves can disrupt melatonin secretion in a portion of the population, then a significant increase in nocturnal RF transmission levels in a residential neighborhood would be expected to produce an increase in sleep problems, and over the long run, an increase in the incidence of breast and prostate cancer. The first evidence of such an effect would be a significant increase in complaints of sleep disruption. It might require several years of exposure for the increase in cancer incidence to reveal itself.

If we use complaints of sleep disruption as a marker for this effect, we can suspect that the recent installation of MESH-networking smart meters in California and in other municipalities around the world has pushed many residential areas across a threshold, producing chronodysruption in a significantly increased portion of the population. The early evidence for this is that these smart meter rollouts have been followed by a dramatic increase in complaints of sleep difficulties received by physicians, by public utility commissions, and in postings on the internet.

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RADIOFREQUENCY EXPOSURE INCREASES OXIDATIVE STRESS AND DAMAGES DNA

Over the past 20 years, a great deal of research evidence has accrued which demonstrates that EMF and RF can alter cellular physiology.

INDUCTION OF STRESS PROTEINS

When cells are stressed in a way that damages DNA in cells, an early response of the cellular physiology is to increase the production of proteins involved in the repair of these structures. These repair proteins are called stress proteins or “heat shock” proteins (since early research models used heat to stress the cells). Increased production of these proteins are direct evidence of physiologic stress and damage to cell DNA, as they represent the effort of the cell to protect against and repair that damage.

The physiologic stressors that trigger this response stimulate specific regions on the cell’s chromosome. These regions initiate the transcription of the stress response genes that encode for these repair proteins.

In the late 1990’s research demonstrated that EMF exposures can produce these stress proteins. (Lin et al., 1997) (DiCarlo et al., 1998)

Further research demonstrated that EMF/RF stimulation promotes gene transcription at different promotion sites than those triggered by heat stress (Lin et al., 1998) (Lin et al., 1999), and that this promotion by EMF/RF can occur at power levels that are not high enough to produce thermal changes in the cells. (DiCarlo et al., 1999) (Weisbrot et al., 2003) (Blank and Goodman, 2004) (Blank, 2007)

Subsequent research has shown that at DNA transcription sites activated by low level EMF and RF exposure, higher levels of exposure can lead to single or double strand breakage of the DNA chain. (Blank and Goodman, 2009)

Current research confirms production of the stress protein response by microwave signals in the 900 MHz and 1800 MHz bands. (Cao et al., 2011) (Jiang et al., 2012) (Calabro et al., 2012)

DNA DAMAGE

Many research studies performed in the last decade have demonstrated that radio frequency radiation at nonthermal levels can produce fragmentation of DNA.

In 2003, Ivancsits reported that intermittent low frequency EMF could cause single and double strand breaks in DNA at magnetic flux densities as low as 35 microtesla, well below levels producing thermal effects. Effects were time and dose dependent. (Ivancsits et al., 2003)

This work was confirmed in 2004 in a study showing that 24 to 48 hour exposures to a 0.01 mT 60 hz magnetic field could produce single and double strand DNA cleavage, apoptosis, and necrosis of brain cells in rats. These effects could be blocked with antioxidants, suggesting that free radicals played a role in the damage process. (Lai and Singh, 2004)

Subsequent research demonstrated that these effects also could be produced by nonthermal effects of radiofrequency microwave exposures—at power levels that were below the levels producing thermal effects—and that this nonthermal damage could be prevented by administration of antioxidant free radical scavengers. (Adlkofer, 2006)

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The results of in vitro studies on DNA damage from EMF/RF are variable, since different cell types have different sensitivities to these effects. (Schwarz et al., 2008) Several detailed reviews of these studies have been published in the last five years. These reviews document multiple studies showing production of DNA damage at low power densities, with more prolonged exposure times producing more significant effects. (Lai, 2007) (Ruediger, 2009) (Phillips et al., 2009) (Levitt and Lai, 2010)

Current research continues to validate these findings. For example, Cam and Syhand found an increase in the production of single strand DNA breaks in hair root cells following 15 to 30 minutes of mobile phone use. (Cam and Seyhan, 2012)

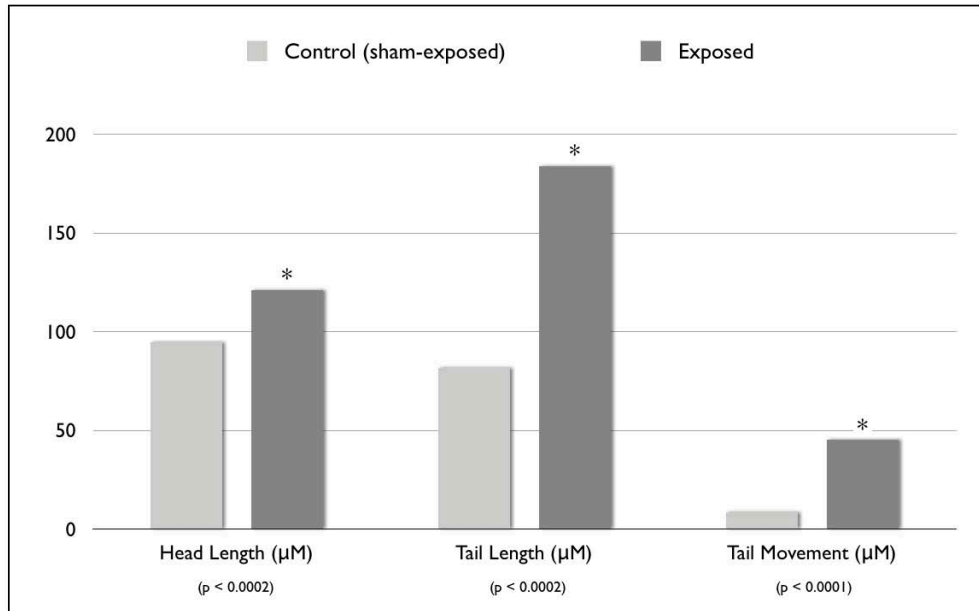


Figure 1: Comet Assay of DNA fragmentation in rat brains, produced by prolonged exposure to microwave RF. (Kesari et al., 2010a)

Kesari et. al. exposed Wistar rats to 2.45 GHz frequency at 0.34 mW/cm² power density (340 μW/cm², whole body SAR ~ 0.11 W/Kg), 2 hours a day for 35 days, and demonstrated increased double strand DNA breakage (p ≤ 0.0002) in brain tissue. This was accompanied by decreased activity levels of glutathione peroxidase (p < 0.005) and superoxide dismutase (p < 0.006), and increased catalase activity (p < 0.006) suggesting that the microwave exposure produced severe oxidative stress. (Kesari et al., 2010a)

Kumar et. al. exposed Wistar rats to 50 GHz continuous source microwave transmission, 2 hours a day for 45 days, with a power density of 0.86 μW/cm² (calculated SAR 8.0 x 10⁻⁴ W/kg). Other rats were exposed to 10 GHz, 2 hours a day for 45 days, power density 0.214 mW/cm² (214 μW/cm², SAR 0.014 W/kg). Both forms of exposure produced significantly altered levels of reactive oxygen species, antioxidant enzyme activity, and blood cell micronuclei formation, demonstrating the production of oxidative stress with genotoxic effects. (Kumar et al., 2010)

RF EXPOSURE PRODUCES OXIDATIVE STRESS

It is a truism among apologists for the telecommunications industry that microwave radiofrequency transmissions cannot possibly cause cancer, because the energy of a photon of this wavelength is not powerful enough to directly break an ionic

SECTION 4 – OXIDATIVE STRESS, DNA DAMAGE, CANCER AND INFERTILITY

bond the way an xray can, and therefor could not possibly cause mutations in DNA. Such an argument sounds like good physics, but it isn't good biology. Ionizing radiation is only one way to cause the mutations in DNA that can produce cancer.

Chronic inflammation can cause cancer. Cigarette smoke can cause cancer. Toxins and autoimmune disease can cause cancer. One common pathway shared by these causes is that they produce an inflammatory response in the body that increases the activity of free radicals (reactive oxygen species). These free radicals produce oxidative damage in the tissues.

This oxidative activity is the tool that our bodies use to destroy foreign bacteria, which can be completely broken up—DNA and all—and digested by our immune system. Free radicals are an important defensive weapon for our bodies, but an excess of oxidative activity can lead to damage of our own tissues. Such excesses have been associated with many chronic problems including autoimmune disease, heart disease, and some forms of cancer. Every week another article is published suggesting that taking antioxidants may be protective against some of these problems.

The mechanisms through which EMF/RF increase oxidative stress in living tissues have not been clearly elucidated, although some ideas have been proposed. (Liboff, 2010) (Georgiou, 2010)

But in the last decade, the scientific research clearly established that EMF and RF exposure cause an increase in reactive oxygen species in living tissues, leading to oxidant damage of DNA. (Shiroff, 2008)

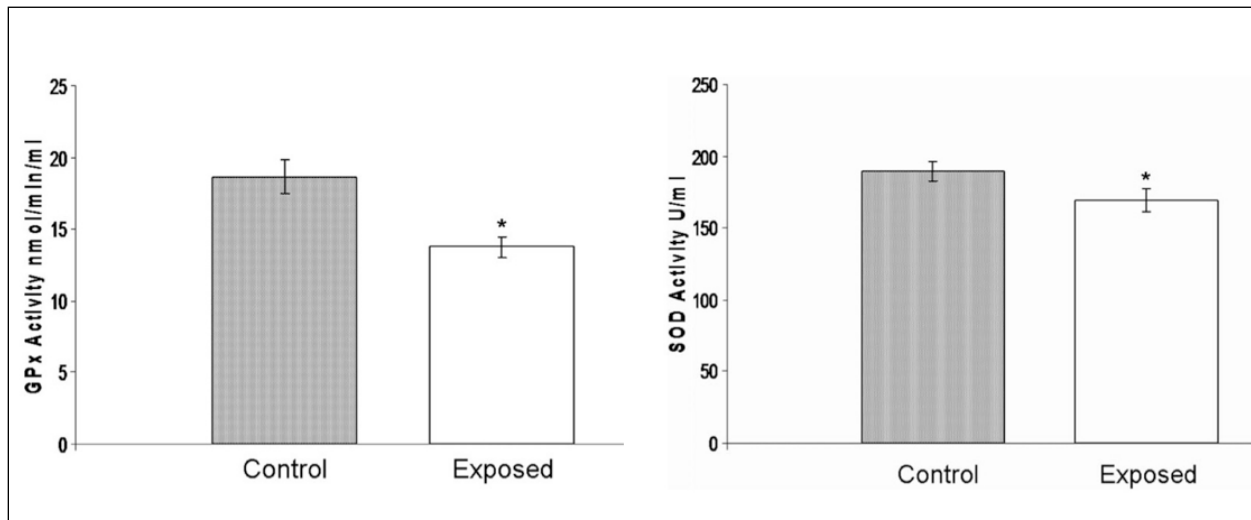


Figure 2: Depletion of antioxidants in RF-exposed rat brains, after exposure to 2.45 GHz, 2 h a day for 35 days at 0.34 mW/cm² power density, 2.45 GHz frequency. (Kesari et al., 2010a)

Studies cited above document that microwave RF exposures at very low power densities produce oxidant stress accompanied by DNA damage. (Kesari et al., 2010a) (Kumar et al., 2010)

Other recently published studies also show that RF exposure can increase oxidant stress and tissue damage in brain tissue (Maaroufi et al., 2011) (Avci et al., 2012), liver tissue (Guler et al., 2012), white blood cells (Lu et al., 2012), and human salivary glands (Hamzany et al., 2012).

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SUPPRESSION OF MELATONIN SECRETION COMPOUNDS THE PROBLEM.

The problems caused by increased oxidative stress from EMF/RF are compounded by the fact that EMF/RF can also suppress melatonin secretion by the pineal gland, since melatonin is one of the most potent antioxidant molecules produced in the body.

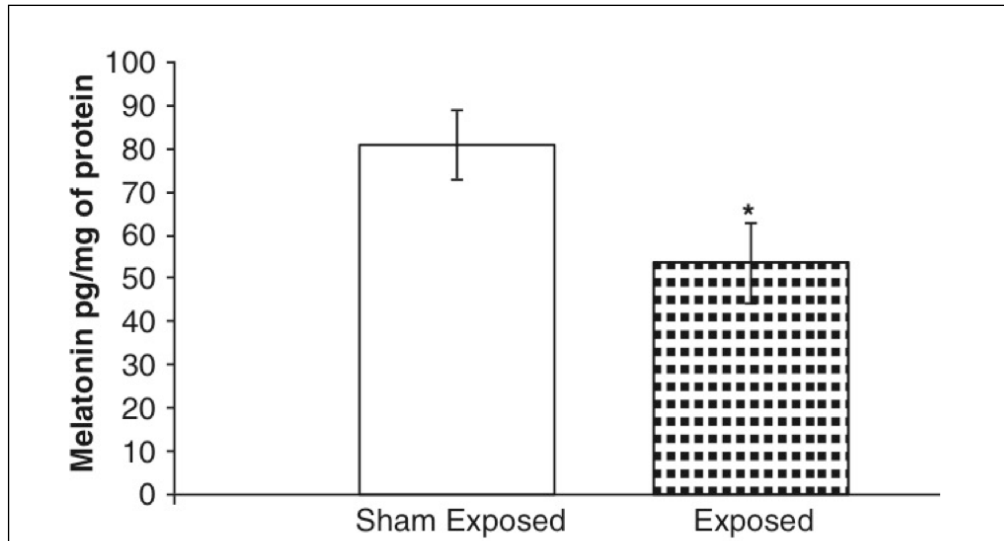


Figure 3: Suppression of melatonin secretion by 2.45 GHz RF, 2 hours a day for 45 days at 0.21 mW/cm². (Kesari et al., 2012)

In recently published study, Kesari et. al. exposed Wistar rats to 2.45 GHz microwave radio transmission, 2 hours a day for 45 days, at a power density of 0.21 mW/cm² (210 μW/cm², whole body SAR ~ 0.14 W/kg). Pineal melatonin was significantly decreased in the exposed group. (Kesari et al., 2012)

Multiple studies have documented that exposure to microwave RF can reduce melatonin levels in animals and in people. (see Section 3).

CONSEQUENCES OF OXIDATIVE DAMAGE TO DNA**EVIDENCE FOR CANCER**

When DNA is damaged, the body attempts to repair it. Errors in DNA coding sequence produced during the repair process can produce mutations. And it is hypothesized that such mutations in DNA are a major cause of cancer.

So if radio frequency (RF) and microwave (MF) exposure increase oxidative damage to DNA, we would expect to see evidence that chronic RF exposure increased the rate of some forms of cancer. A significant body of epidemiologic research in a variety of exposure settings suggests that this is indeed the case.

Electronics technicians

In the 1980's, Milham published evidence of increased leukemia in electrical workers (Milham, 1985b)

Another study of workers in the electronics industry found an increased risk of brain tumor associated with exposure to microwave radio transmission, with a highly significant increase in risk in those with more than 20 years of exposure. (Thomas et al., 1987)

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A case/control study of brain cancer deaths in Maryland found a threefold greater brain cancer incidence in electrical or electronic engineers and technicians, compared to the reference population. (Lin et al., 1985)

A study of leukemia rates in different occupational groups in the U.S. Navy showed increased leukemia risk in electrician's mates. (Garland et al., 1990)

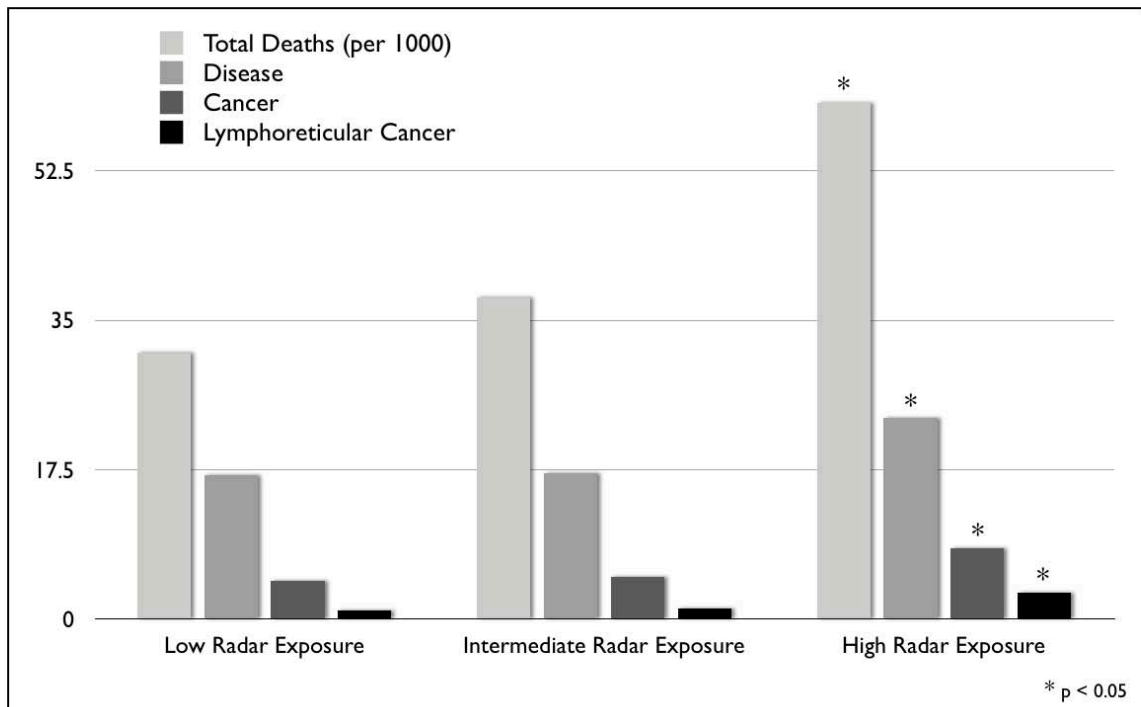


Figure 4: Mortality (1950–1974) in U.S. Navy Korean War Veterans, stratified by in-service levels of occupational radar exposure. (Cherry, 2002a, after Robinette, 1980)

A study performed for the U.S. military published data comparing a cohort of 20,000 Korean War veterans with higher occupational exposure levels to RF/MW exposure to 208,000 Korean war veterans with minimal occupational exposure during their service years. Mortality statistics were reviewed for the interval between 1950 and 1974. (Robinette et al., 1980) This data shows that the group with the highest rated occupational exposure level (aviation electronic technicians) had a significantly higher total death rate during the study period, and a higher death rate from disease, from malignancy, and from lymphatic and hematopoietic malignancies. (Goldsmith, 1997a)

A study of Polish career military personnel from 1971 – 1985 showed double the risk of cancer in personnel with occupational exposure to RF/MW transmission, as compared other personnel. The exposed cohort had higher morbidity rates for GI cancers (Observed versus Expected Ratio = 3.19 – 3.24), brain tumors (OER = 1.91), and hematopoietic malignancy (OER = 6.31), including chronic myelocytic leukemia (OER = 13.9), acute myeloblastic leukemia (OER = 8.62), and non-Hodgkin's lymphoma (OER = 5.82). (Szmigielski, 1996)

Radio Operators

Increased rates of acute myeloid leukemia and of other lymphatic malignancies have been found in large population based studies of amateur radio operators (Milham, 1985a) (Milham, 1988a) (Milham, 1988b).

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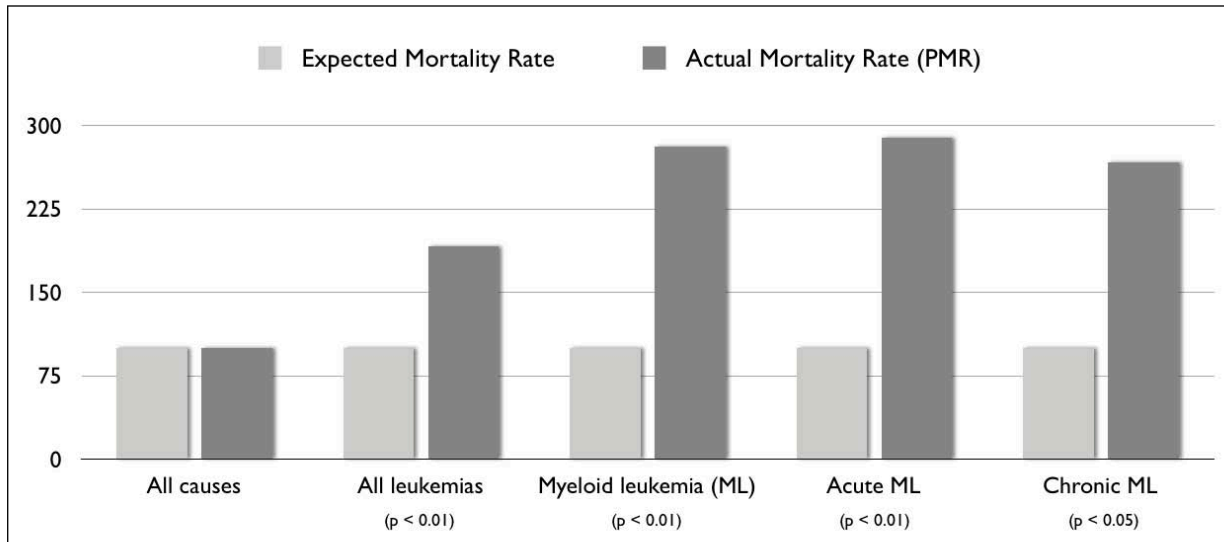


Figure 5: Analysis of leukemia deaths in male members of the American Radio Relay League resident in Washington and California, 1971 – 1983. (Milham, 1985a)

Another study of female radio and telegraph operators in Norway found an increased incidence of breast cancer in this group as compared to the standardized incidence rate in the female population of that country. (Tynes et al., 1996)

Police radar operators

Two studies have shown increased rates of testicular cancer (Davis and Mostofi, 1993), and of testicular cancer and melanoma (Finkelstein, 1998) in police officers with occupational exposure to handheld radar.

Airline pilots

Airline pilots have significant occupational exposure to RF/MF (radio frequency and microwave frequency) transmissions.

A study of U.S. Air Force personnel showed an increased risk of brain tumors associated with increasing rank, and associated with estimated exposures to both microwave radio and low frequency radio transmissions. No increased risk associated with exposure to ionizing radiation was found in this study population. (Grayson, 1996)

A study of commercial airline pilots in Iceland found an increased risk of malignant melanoma. (Rafnsson et al., 2000) Another study with Danish pilots showed increased risk of total cancer, melanoma, other skin cancers, and acute myeloid leukemia in commercial airline cockpit crews. (Gundestrup and Storm, 1999) Neither of these studies specifically controlled for RF/MF exposures as compared to other exposures (cosmic rays, tropical sun on the beach, etc.) incurred by flying personnel.

However, an extensive study of German commercial airlines crews (including 6,017 cockpit and 20,757 cabin crew members) showed an increased brain cancer risk for cockpit crew and an increased all cancer risk for cockpit crew with more than 30 years employment compared to those with under 10 years of employment. Notably, these increased risk were not found in cabin crew members, who share equal exposure to cosmic rays and tropical beaches, but are farther from the radios. (Zeeb et al., 2010)

U.S. Embassy Moscow 1953 – 1976

From the 1950's to the mid-1970's the U.S. Embassy in Moscow was exposed to a

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constant low intensity radar signal, as a form of harassment by the Russian government. The exposure level on the outside of the west facade of the building was measured at 5 microwatts/cm², and was present for 9 hours a day. Since the wall and windows attenuated the signal, inside exposure levels were likely to be in the range of 0.02 to 0.1 $\mu\text{W}/\text{cm}^2$.

The State Department contracted an epidemiologic analysis potential health effects on exposed personnel and their dependents, which was performed by A.M. Lilienfeld M.D., and epidemiologist at John's Hopkins University. This report was published including all of the tabulated raw data. (Lilienfeld AM, 1979)

The report as finally released stated as a conclusion that personnel "suffered no ill effects" from the microwave exposure. However, the published conclusions differed from the original conclusions written by Dr. Lilienfeld, and evidence suggests that the final conclusions were "whitewashed". (Goldsmith, 1997b) One can presume that this might have been done to avoid embarrassment of the federal government, since any harm, if produced, would have been produced at levels of exposure orders of magnitude less than those exposure levels permitted by United States FCC guidelines.

A hematologic study performed on employees at the Moscow embassy was submitted to the U.S. government in October, 1976. This study showed significant abnormalities in hematologic parameters in this group, in comparison with studies of foreign service workers in the United States. (Goldsmith, 1997a)

The published data from the Lilienfeld study of Moscow embassy workers and their dependents has subsequently been analyzed by other epidemiologists and found to show a statistically significant increase in total adult and childhood cancers, in breast cancer, and in childhood leukemia. (Goldsmith, 1995) (Cherry, 2002a)

Residential exposure to Radio/TV Transmission towers

By the late 1990's, a significant body of epidemiologic literature had accumulated that demonstrated an association between exposure to radar and RF radiation and the occurrence of certain types of cancer.

Evidence for association between radio transmission tower exposures and adult and/or childhood leukemia has been reported in studies from Hawaii (Maskarinec et al., 1994) and Australia (Hocking et al., 1996).

A study from England shows an increased risk of adult leukemia in those residing within two kilometers of the transmission tower, and decreased risk of leukemia, skin cancer, and bladder cancer with increased distance of residence from the tower. (Dolk et al., 1997b) A follow-up study involving multiple other sites in England also showed a statistically significant decline in risk of adult leukemia with increasing distance of residence from transmission sites. (Dolk et al., 1997a) (Hocking et al., 1998)

A study in Rome evaluated the incidence of adult and childhood leukemia as a function of residential proximity to the Vatican Radio transmission tower. Pediatric leukemia cases were more common than expected at less than 6 kilometers from the tower, and significantly elevated in adult men living within 2 km of the tower. Adult male leukemia mortality and childhood leukemia rates showed a significant decrease with increasing distance between tower and residence. (Michelozzi et al., 2002)

A study of cancer incidence in proximity to the Sutro radio/TV tower in San Francisco also showed a strong correlation of exposure and incidence of several types of childhood cancer. (Cherry, 2002b) This study was notable for its rigor in analyzing the actual exposure levels around the tower in relation to the data set. Power density/

SECTION 4 – OXIDATIVE STRESS, DNA DAMAGE, CANCER AND INFERTILITY

exposure levels around UHF and VHF broadcasting antennae are not distributed in a simple and symmetrical regression (“with the square of the distance”). Transmission exposure levels form a series of peaks and valleys around these antennae, and the antennae can be arranged to focus more power in one direction than another, aiming a stronger signal at the target audience in a population center. Studies that fail to take this distribution into account and assume that exposure is in direct ratio to distance will mix higher and lower exposure groups together, diluting the power of the study and underestimating true risk in relation to exposure.

In another paper, Dr. Cherry analyzes this issue in detail, and uses his more rigorous approach to review and refine the analysis of data from many of the earlier studies on health effects of radio/TV broadcast towers. His analysis strengthens the evidence for increased cancer risk from these exposures. (Cherry, 2002a)

A large population case/control study in south Korea looked at 1928 leukemia patients and 956 brain cancer patients under 15 years of age who were diagnosed between 1993 and 1999 at 14 large hospitals in Korea. These cases were matched with 3082 age matched patients who received respiratory disease diagnoses (primarily asthma) at the same hospitals during the study period. Case and control exposure levels were calculated for 31 transmitters in South Korea that had a transmission power greater than 20 kW, using a mathematical model that was correlated with field testing. Children residing within 2 kilometers of a transmission tower had a significantly increased risk of leukemia as compared to children with residence greater than 20 km from the tower (OR 2.15, 95% CI = 1.00 to 4.67). (Ha et al., 2007)

Residential Exposure to Cell Phone Tower (Base Station) Transmissions

With the dramatic rollout of commercial cell phone service in the 1990’s, large segments of the population became exposed to significantly higher levels of microwave RF exposure due to the installation of cell phone towers in urban areas. Several recent papers have reviewed the significant evidence for ill effects from these urban exposures. (Khurana et al., 2010) (Yakymenko et al., 2011) (Kumar, 2010)

Netanyu, Israel

Wolf and Wolf studied rates of cancer incidence during the second year of operation of a 1500 watt 850 MHz cell phone tower in Netanya, Israel. The study group was composed of 622 individuals who had lived in area A, within 350 meters of the tower, for the previous 3 to 7 years. A control group of 1,222 individuals living in an outlying area B was also studied.

During the study year, 8 cases of cancer occurred in the study group, and 2 cases occurred in the control group. The cancer rate for the entire town was 31 cases per 10,000. Relative cancer rates for females was 10.5 for the study group, 0.6 for the control group, and 1.0 for the town as a whole ($P < 0.0001$).

Signal power densities of the tower’s transmissions in the homes of the cancer cases ranged from 0.3 – 0.5 $\mu\text{W}/\text{cm}^2$. [note that FCC limits are 600 – 1000 $\mu\text{W}/\text{cm}^2$.]

In the year following the close of the study, another 8 new cases of cancer occurred in area A, and another 2 cases occurred in area B. (Wolf and Wolf, 2004)

Naila, Germany

A cell phone transmission tower was placed in the town of Naila, Germany, in 1993. Eger, Hagen, et. al. reviewed the medical health records from 1994 to 2004 for around 1000 residents of the municipality (roughly 90% of the population). All

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included patients had been living at the same address during the entire 10 years of observation.

Over the course of the entire study period, patients living in an inner area within 400 meter of the transmission tower had 2.27 times the relative risk of cancer incidence, compared to patients living more than 400 meters from the tower ($p < 0.05$). Cancer patients in the inner residential area also developed cancer an average of 8.5 years earlier in life than did cancer patients residing in the more distant area.

For the years 1999 to 2004 (after 5 years of tower operation) the relative risk of cancer incidence in residents less than 400 meters from the tower increased to 3.29 ($p < 0.01$). Relative risk of breast cancer was 3.4 in the inner area, where average age of diagnosis was 50.8 years, compared to 69.9 years in the outer area. (Eger et al., 2004)

Hausmannstätten and Vasoldsberg, Austria

Oberfeld performed a case/control study of cancer patients in the municipalities of Hausmannstätten and Vasoldsberg, Austria. All subjects had resided within 1,200 meters of an analogue cell phone tower that operated between 1984 and 1997 in the municipalities.

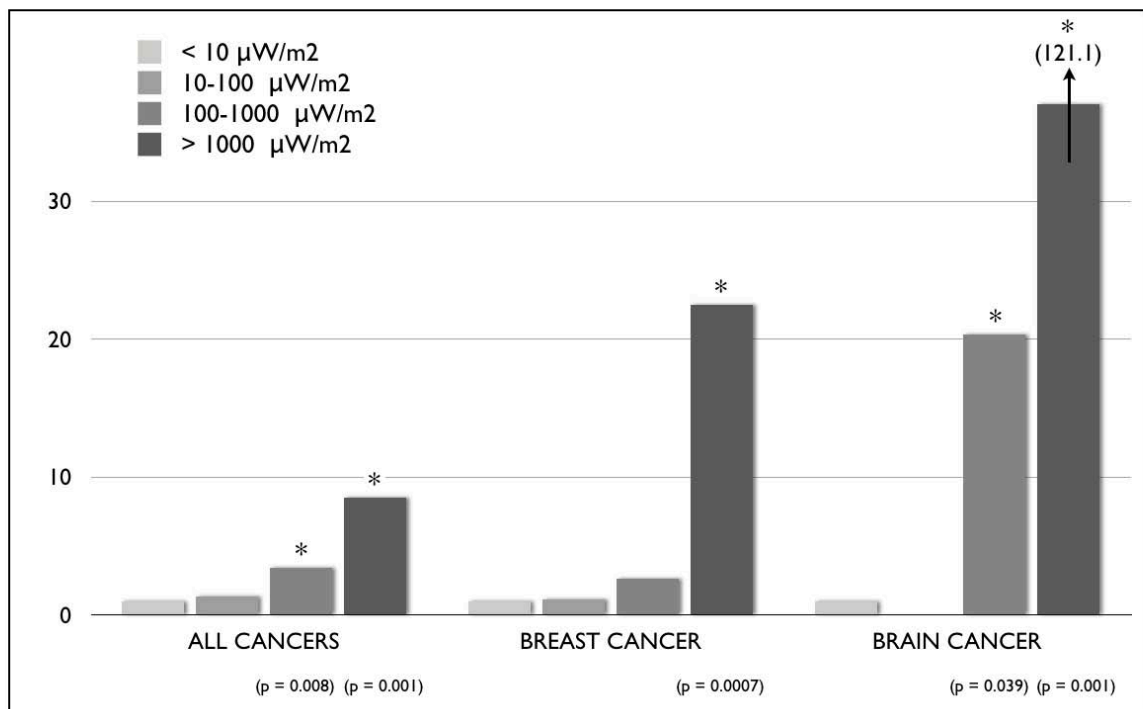


Figure 6: Odds ratio of cancer incidence, stratified by exposure levels (exterior to dwelling) in $\mu\text{W}/\text{m}^2$. (Oberfeld, 2008)

Residential outdoor exposure levels were measured, and three different case/control groups were assessed, for case exposure levels outside the residence of 10 – 100 $\mu\text{W}/\text{m}^2$ ($= 0.001 - 0.01 \mu\text{W}/\text{cm}^2$), 100 – 1000 $\mu\text{W}/\text{m}^2$ ($= 0.01 - 0.1 \mu\text{W}/\text{cm}^2$), and greater than 1000 $\mu\text{W}/\text{m}^2$ ($> 0.1 \mu\text{W}/\text{cm}^2$). respectively. The reference exposure level for the control group was less than 10 $\mu\text{W}/\text{m}^2$ ($= 0.001 \mu\text{W}/\text{cm}^2$). [Note that FCC thermal safety limits are 6,000,000 to 10,000,000 $\mu\text{W}/\text{m}^2$.]

Cancer risk for all cancers was significantly elevated for all three elevated exposure categories, and was 5 to 8 times higher in the $>1000 \mu\text{W}/\text{m}^2$ ($> 0.1 \mu\text{W}/\text{cm}^2$) cate-

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gory ($p=0.001$). In this highest risk group, breast cancer risk was 23 times higher ($p = 0.0007$) and brain tumor risk was 121 times higher ($p = 0.001$). (Oberfeld, 2008)

Belo Horizonte, Brazil

Dode et. al. studied deaths from cancer in the city of Belo Horizonte in southern Brazil from 1996 to 2006. This city of over 2 million inhabitants was rated by the United Nations in 2007 as having the best quality of life in Latin America. The researchers used the database of deaths by neoplasm of the City Health Department, the database of cell phone base station sites from the Brazilian Telecommunications Agency, and a database of the city census and demographics. Exposure duration was calculated from the date of installation of the first antenna to which the individual had been exposed, and residential distance from that exposure was calculated in 100 meter increments.

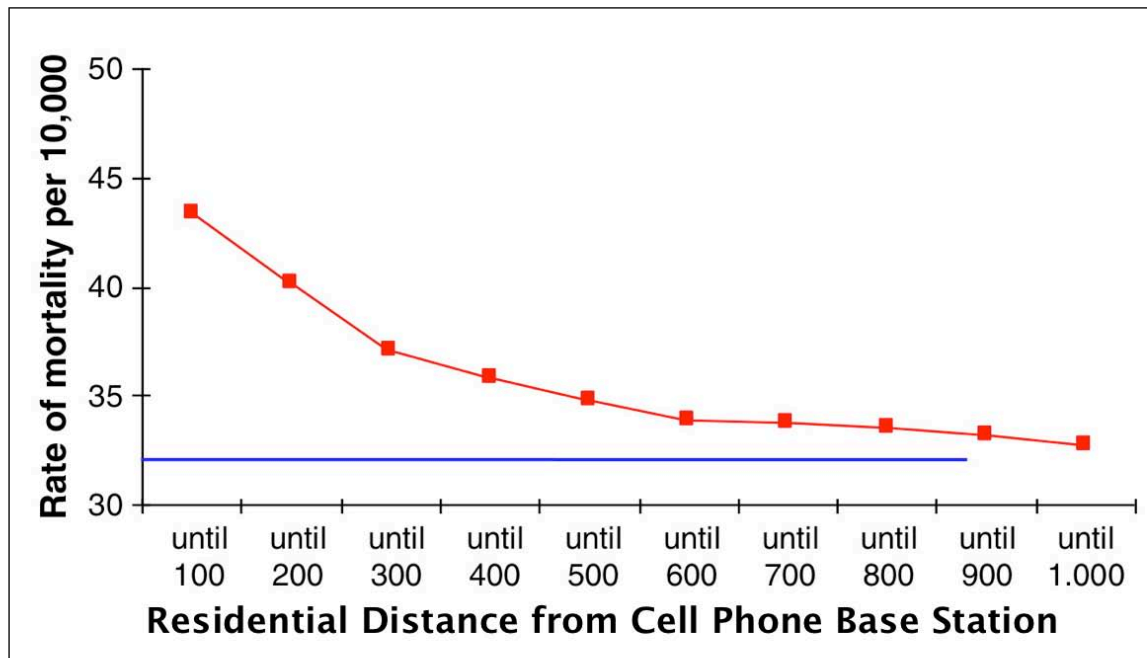


Figure 7: Cancer death rate as function of residential proximity to cell phone transmission towers in meters. Horizontal line = null hypothesis. (Dode et al., 2011)

The highest concentration of base stations was in the south central part of the city. In 2008, environmental monitoring of microwave radiation was performed at 400 sites, measuring frequency bands between 800 MHz and 1800 MHz. Signal intensity averaged 7.32 V/m ($\sim 14.2 \mu\text{W}/\text{cm}^2$), with a range from 0.4 to 12.4 V/m (~ 0.04 to $40.7 \mu\text{W}/\text{cm}^2$). These intensity levels are well below the ICNIRP guidelines for microwave radiation exposure, which are based on protection against thermal effects.

Analysis of the data showed that cancer mortality rates were higher near the cell phone transmission towers. Within the range of 100 meters of a tower, the mortality rate was 43.42 persons per 10,000 (compared to a rate of 32.12 per 10,000 for the city as a whole), with a relative risk of 1.35.

The mortality rate reduced in proportion to residential distance from cell phone tower. Relative risk of cancer mortality was clearly elevated at residential distances of 500 meters or less from a cell transmission tower (base station, or BS) as illustrated in Figure 7. (Dode et al., 2011)

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Taiwan

Li et. al. performed a case/control study of 2606 children age 15 or less who were diagnosed with a neoplasm in Taiwan between 2003 and 2007. Each case was matched with 30 controls. Residential exposure of cases and controls was calculated based on the annual power density in watt-years per kilometer squared for each of the 367 townships in Taiwan, averaged out for the 5 year period prior to diagnosis in the township where the subject resided at time of diagnosis.

This study is notable for the large number of cases and controls, which should increase the power of the study. On the other hand, if elevated microwave exposure is associated with cancer risk, assuming that power density of cell phone tower transmissions is constant throughout each township would serve to minimize the effects of higher exposure levels closer to the towers, minimizing the distinction between higher and lower cohorts, and diluting the power of the study.

Case/control analyses were performed for “all cancer types”, for leukemia, and for brain neoplasm. Odds ratio for cases of “all cancer types” with calculated exposure greater than median exposure value of controls were significantly elevated at 1.13 (95% CI = 1.01 to 1.28). Odds ratio for cases of leukemia with calculated exposure greater than median exposure value of controls were elevated at 1.23 (95% CI = 0.99 to 1.52). Odds ratio for cases of brain neoplasm with calculated exposure greater than median exposure value of controls were slightly elevated at 1.14 (95% CI = 0.83 to 1.55). (Li et al., 2012)

EVIDENCE FOR IMPAIRMENT OF FERTILITY

Toxic exposures that damage DNA can cause cancer. They can also cause damage to the production of healthy eggs and sperm, leading to infertility. If microwave RF exposure causes oxidative damage to DNA, this should lead to measurable alterations in function of reproductive function and fertility. Current research is beginning to prove the presence of this effect.

Laboratory studies in insects

In 2004, Panagopoulos et. al. demonstrated that exposure to a modulated GSM 900 MHz cell phone signal for 6 continuous minutes daily for two days decreased the fertility of both male and female fruit flies (*Drosophila melanogaster*). Exposure power density was ~ 0.436 milliwatts/cm² ($= 436 \mu\text{W}/\text{cm}^2$). (Panagopoulos et al., 2004)

In a later study, Panagopoulos et. al. exposed *Drosophila* fruit flies to a cell phone transmitting GSM 900 MHz at $0.40 \text{ mW}/\text{cm}^2$ ($= 400 \mu\text{W}/\text{cm}^2$ —Group 1) or GSM 900 MHz at $0.29 \text{ mW}/\text{cm}^2$ ($= 290 \mu\text{W}/\text{cm}^2$ —Group 2), or DCS 1800 MHz at $0.29 \text{ mW}/\text{cm}^2$ ($= 290 \mu\text{W}/\text{cm}^2$ —Group 3). Transmission exposures were 6 consecutive minutes per day for six days. The exposure induced fragmented DNA during oogenesis. Cell death scores in the ovaries of female flies were 63% in Group 1, 45% in Group 2, and 39% in Group 3, as compared to 7.8% in the sham and control groups. (Panagopoulos et al., 2007)

Subsequent research exposed *Drosophila* fruit flies to GSM 900 MHz or DCS 1800 MHz signals for signal durations of 1 to 21 minutes a day for five consecutive days, at a power density of $10 \mu\text{W}/\text{cm}^2$. Impairment of fertility increased linearly with duration of exposure (see figure 2). Even at 1 minute of exposure a day, fertility was significantly decreased in exposed versus sham exposure specimens ($p < 0.00001$). (Panagopoulos and Margaritis, 2010)

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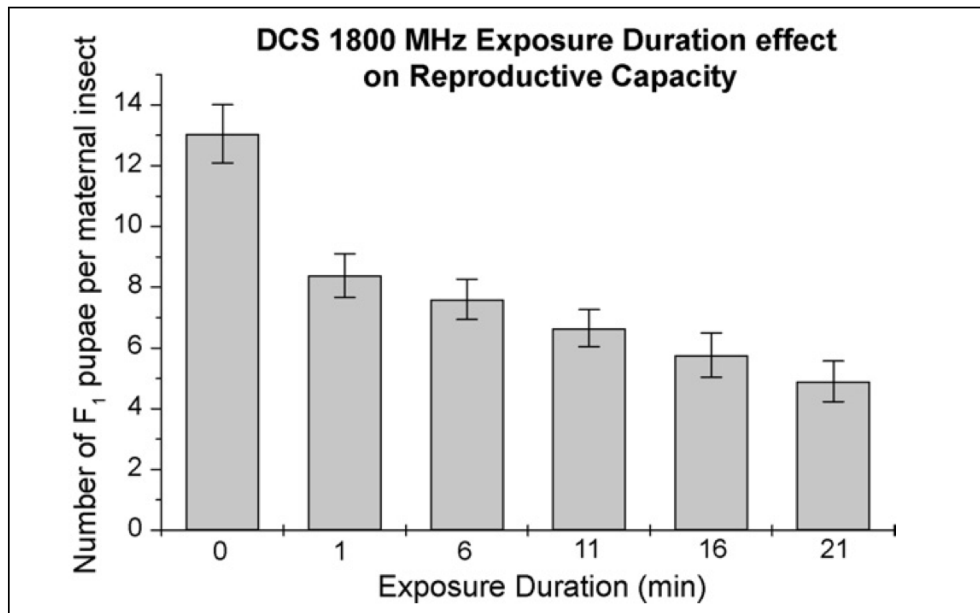


Figure 8: Decreased fertility of fruit flies at exposure level of $10 \mu\text{W}/\text{cm}^2$.
(Panagopoulos and Margaritis, 2010)

In another study using a GSM 900 MHz cell phone signal at $0.35 \text{ mW}/\text{cm}^2$ ($= 350 \mu\text{W}/\text{cm}^2$), six minutes of daily exposure was divided into one, two, or three minute segments, spaced 10 minutes apart. This was compared with one 6 minute constant exposure and with two 3 minute exposures spaced 6 hours apart. DNA damage and cell death in the intermittent exposures sequenced 10 minutes apart was essentially the same as with the constant 6 minute exposure ($p > 0.92$), and markedly higher than in the sham group ($p < 10^{-8}$). The group with divided exposures 6 hours apart had less cell death than the more frequently exposed group, but still showed significantly higher infertility than the control group ($p < 0.002$). (Chavdoula et al., 2010)

In yet another study, the Panagopoulos group evaluated influence of GSM 900 MHz and 1800 MHz cell phone transmissions on *Drosophila* fertility using exposures of 6 minutes per day for 6 days, at exposure distances varying from 0 to 100 cm. They were able to demonstrate an adverse effect on fertility for all exposures at all power densities greater than or equal to $1 \mu\text{W}/\text{cm}^2$. (Panagopoulos et al., 2010)

Recently Panagopoulos published another study demonstrating that exposure to a GSM 900 MHz modulated cell phone transmissions at $\sim 0.35 \text{ mW}/\text{cm}^2$ ($= 350 \mu\text{W}/\text{cm}^2$) for 6 minutes during ovarian development can seriously retard ovarian maturation and reduce final size of ovaries in *Drosophila* fruit flies. (Panagopoulos, 2012)

Laboratory studies in animals

Magras and Xenos placed caged mice at various locations in an antenna park in Thessaloniki, Greece, at locations with RF power densities ranging from $168 \text{ nW}/\text{cm}^2$ ($= 0.168 \mu\text{W}/\text{cm}^2$) to $1053 \text{ nW}/\text{cm}^2$ ($= 1.053 \mu\text{W}/\text{cm}^2$). The mice lived in these locations for six months, during which time they were mated repeatedly. Numbers of newborns per litter decreased progressively, and ended with complete infertility by the fifth mating cycle. This infertility was not reversible with removal to an unexposed laboratory environment. (Magras and Xenos, 1997)

Meo et. al. exposed Wistar rats to cell phone transmissions for either 30 or 60

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minutes a day for 3 months, and then measured serum testosterone levels. Testosterone levels decreased with increased duration of exposure, and the difference in testosterone level between subjects and controls was statistically significant in the 60 minutes per day group ($p < 0.02$) (Meo et al., 2010)

Otitolaju et. al. evaluated sperm head morphology in laboratory rats that were exposed to cell tower transmissions at two locations with mean RF exposure levels of 489 ± 43 mV/m ($\sim 0.6 \mu\text{W}/\text{cm}^2$) and 625 ± 25 mV/m ($\sim 0.10 \mu\text{W}/\text{cm}^2$). A control group was held in a laboratory with RF exposure levels of 59 ± 17 mV/m ($\sim 0.001 \mu\text{W}/\text{cm}^2$). After six months of exposure, exposed rats showed mean sperm head abnormalities of 40% and 46%, versus 2% in control animals. (Otitolaju et al., 2010)

Kesari and Behari exposed male Wistar rats to 50 GHz continuous microwave radiation at a power density of $0.86 \mu\text{W}/\text{cm}^2$ (calculated SAR 8×10^{-4} W/kg), 2 hours a day for 45 days. Sperm cells showed significant reductions of glutathione peroxidase and superoxide dismutase activity ($p \leq 0.05$) and increased catalase activity ($p < 0.02$), consistent with a significant increase in oxidative stress. Histone kinase activity was also increased ($p < 0.016$), and significantly increased apoptosis (programmed cell death) and alteration in phases of sperm development were also present. (Kesari and Behari, 2010)

In a similar study, Kesari et. al. confirmed a significant increase in cell death through apoptosis, reduced sperm count, and reduced protein kinase C activity in male Wistar rats exposed to cell phone transmissions 2 hours daily for 35 days. Exposure power densities ranged from $0.1 - 2.0 \text{ mW}/\text{cm}^2$ ($= 100 - 2000 \mu\text{W}/\text{cm}^2$, calculated SAR $0.9 \text{ W}/\text{kg}$). (Kesari et al., 2010b)

In 2011 and 2012 Kumar and Kesari published four additional papers documenting the adverse effects of 10 GHz microwave exposure (2 hours daily for 45 days at power density of $0.21 \text{ mW}/\text{cm}^2$ ($= 210 \mu\text{W}/\text{cm}^2$, SAR $0.014 \text{ W}/\text{kg}$) on fertility in male Wistar rats. These studies document significant levels of pathological change including increases in reactive oxygen species, increased apoptosis (cell death) in sperm cells and altered sperm cell cycle (Kumar et al., 2011), increased free radical formation, decreased activity of glutathione peroxidase and superoxide dismutase, increased activity of catalase and malondialdehyde, decreased histone kinase (Kesari et al., 2011), reduced testosterone levels, shrinkage of seminiferous tubules and testicular size, distortion of sperm structure, decreased number and weight of progeny (Kesari and Behari, 2012), formation of micronuclei bodies in lymphocytes, DNA strand breakage, altered levels of histone kinase, altered percentage of spermatogenic phases, and (again) reduced testosterone levels and shrinkage of seminiferous tubules. (Kumar et al., 2012)

In 2012, Atasoy et. al. published a study of rats exposed to a WiFi router (802.11.g, 2.437 GHz) for 20 weeks, 24 hours a day. Histological and immunohistochemical examinations of the rats' testes showed evidence of DNA damage compared to controls ($p < 0.05$) and decreased activity levels of antioxidants (catalase and glutathione peroxidase, $p < 0.05$). (Atasoy et al., 2012)

Other animal studies

Experimental laboratory evidence clearly demonstrates that microwave RF radiation can adversely effect reproduction in insects and animals. Some evidence to support this is also available from studies of animals exposed to RF in their natural environment.

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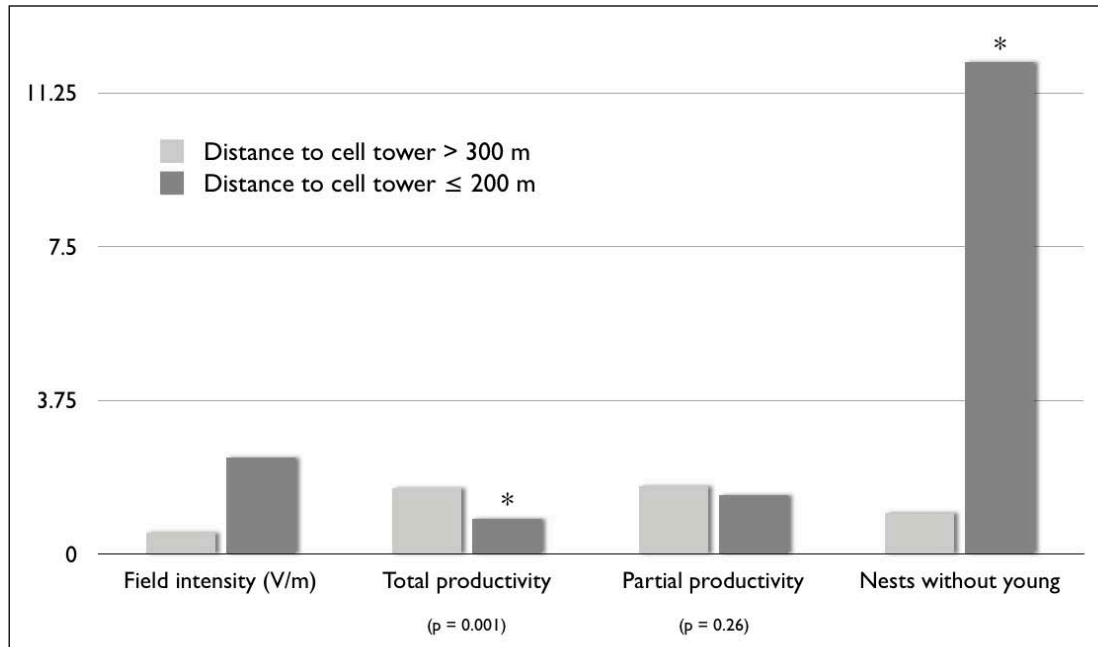


Figure 9: Impaired fertility in white storks nesting near cell phone towers.
(Balmori, 2005)

Balmori studied a white stork population that was nesting near a cluster of cell phone towers in Valladolid, Spain. Power densities at ground level ranged from 10 $\mu\text{W}/\text{cm}^2$ at 50 meters from the towers to 1 $\mu\text{W}/\text{cm}^2$ at 100 meters distance and a tenths of a $\mu\text{W}/\text{cm}^2$ at 150 to 200 meters distance. Total breeding productivity was significantly reduced at nests closer than 200 meters, compared to nests farther than 300 meters from the towers. (Balmori, 2005)

Balmori performed bird counts at 30 locations during 40 visits to Valladolid, Spain, over the interval between October 2002 and May 2006, and measured mean electric field strength at each counting site. Bird population density declined significantly over the observation period ($p = 0.0037$), and population density was significantly lower in areas with higher electric field strength ($p = 0.0001$). (Balmori and Hallberg, 2007)

Balmori also studied reproductive success of common frogs (*Rana temporaria*) at a breeding site 140 meters from a cluster of cell phone towers. Electric field intensities measured at 1.8 to 3.5 V/m (~ 0.9 to $3.2 \mu\text{W}/\text{cm}^2$). Some eggs were in enclosures that were permeable to microwave radiation, and others were shielded in grounded Faraday cages. Exposed eggs showed asynchronous growth with varying tadpole size and a 90% mortality rate, while shielded eggs developed synchronously with a 4.2% mortality rate. (Balmori, 2010a)

Much more work needs to be done on in vivo studies of the effects of microwave cellular transmissions on animals and plants. Two reviews of the existing research have been published. (Balmori, 2009) (Balmori, 2010b)

Human studies

Human sperm counts have been declining for decades. In 1992 Carlsen et. al. published a meta-review of 61 studies published between 1938 and 1991, with 14,947 subjects. They found a decreased in mean sperm count from 113 million/ml to 66 million/ml ($p < 0.0001$) between 1940 and 1990, with a decrease in seminal volume from

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3.40 ml to 2.75 ml ($p = 0.027$). Additionally, the percentage of men with sperm counts < 20 million/ml increased over this time period, while the percentage of men with sperm counts > 100 million/ml decreased. The incidence of testicular cancer increased between two and fourfold during this interval. (Carlsen et al., 1992)

Carlsen's analysis produced controversy initially. But subsequent analysis has shown that their results were essentially correct. Analytic approaches to their data set that refined the analysis to adjust for bias of various kinds have continued to support the validity of their conclusions. (Swan and Elkin, 1999)

In another meta-analysis, Swan et. al. looked at 54 of the most robust studies in the Carlsen data set, and at 47 additional studies, covering studies from 28 countries over a total time interval from 1934 to 1996. They found a rate of decrease in sperm counts of 0.80 million/ml per year in North America and 3.13 million/ml per year in Europe/Australia. (Swan et al., 2000)

And more recent studies have shown that this downward trend in sperm counts is continuing. Jorgensen et. al. found decreasing levels in sperm concentration, total sperm count, and percentage of morphologically normal sperm in Finnish men born in 1987 versus 1982 – 83 versus 1979 – 1981. (Jorgensen et al., 2011) Sperm counts in New Zealand sperm donors decreased 50% between 1987 and 2007, an average of 2.5% per year. (Shine et al., 2008)

In the early 1990's, it was hypothesized that this decrease in sperm counts and increase in testicular pathology might be due to exposure of male embryos to exogenous estrogens (DES, pesticide residues, plasticizers like Bisphenol A, etc.) early in development. (Sharpe and Skakkebaek, 1993) (Carlsen et al., 1995) (Irvine, 1997)

In 1994, Abell et. al. described higher sperm counts in members of a Danish organic farmer's association, as compared with Danish men who had occupational exposures to xenoestrogens. (Abell et al., 1994) Jensen et. al. found a 43.1% higher sperm concentration ($p = 0.033$) in 55 members of Danish organic foods associations who ate at least 25% organic foods, as compared with 141 normal controls. (Jensen et al., 1996)

Multiple studies in animal models have shown that in utero exposures to estrogenic chemicals can alter testicular health and function. Regional variations in sperm count and testicular cancer rates suggest the possibility of environmental influences. A recent paper by Nordkap et. al. reviews current perspectives on this subject. (Nordkap et al., 2012)

On the other hand, estrogenic xenobiotic chemicals have been present in the food chain since the 1950's. Adverse clinical effects of these exposures have been discussed since the early 1960's. (Randolph, 1962) Unless the human body burden of these chemicals has continued to significantly increase over the last 50 years, we would expect the influence of this effect on sperm counts to plateau.

But sperm counts have not plateaued. They have continue to decrease throughout the developed world. A recent study of 26,609 french partners of totally infertile women seeking in vitro fertilization found a 32.2% decrease in sperm concentration between 1989 and 2005, with projected sperm counts for a 35 year old man dropping from 73.6 million/ml to 49.9 million/ml. (Rolland et al., 2012)

This continued trend should be a cause for significant alarm. The World Health Organization defines sperm counts above 20 million/ml as normal. But studies have shown that couples take longer to get pregnant at sperm counts below 40 to 55 million/

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ml. (Bonde et al., 1998) (Guzick et al., 2001) (Slama et al., 2002) In Israel, a recent study of sperm donors showed that over the last 10 to 15 years the average sperm count has dropped from 106 million/ml to 68 million/ml, an average decrease of 2.5 million/ml (0.8%) per year. 15 years ago, 66% of sperm donations were of acceptable quality; using the same criteria, at the current time only 18% of donations would be of acceptable quality. (Haimov-Kochman et al., 2012)

As discussed above, studies in insects and animals have demonstrated that microwave radio exposure at remarkably low power densities can have an adverse effect on male fertility. With the rollout of cellular and WiFi infrastructure, exposure to these radio frequencies has increased dramatically in the last 20 years. Would it be reasonable to ask if such exposures have played a role in the continued decrease in male fertility that has occurred during this time period? The result of several recent studies suggests that the answer to this question is “Yes”.

Erogul et. al. split human sperm samples and exposed one part to signal from a 900 MHz cell phone. They found statistically significant decreases in motility of sperm in the exposed samples. (Erogul et al., 2006)

Fejes et. al. measured semen quality in a cohort of 371 subjects where confounding factors had been excluded, and found a significant decrease in sperm motility ($p < 0.01$) in individuals with talk time > 60 minutes/day versus talk time < 15 minutes/D. Decreased sperm motility also correlated with increased duration of cell phone ownership in months. (Fejes et al., 2005)

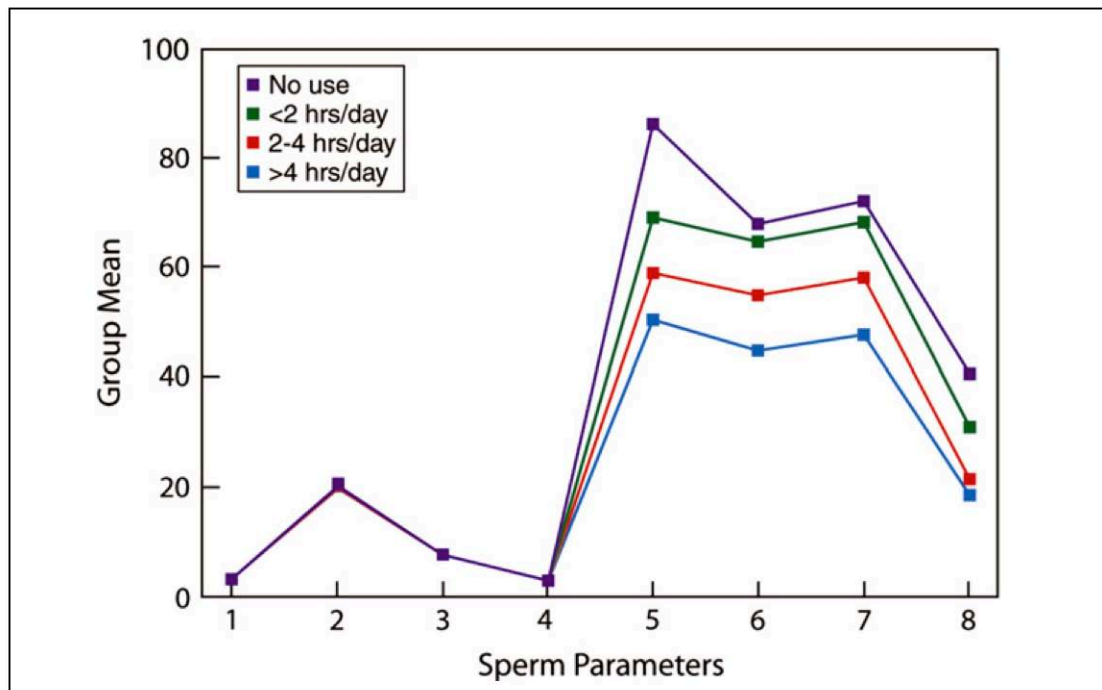


Figure 10: Decrease in sperm count (5), motility (6), viability (7) and normal morphology (8) with increased cell phone talk time. (Agarwal, 2008)

Agarwal et. al. studied semen quality in 361 subjects, divided into four groups based on daily cell phone usage (no use, < 2 hours/day, 2 to 4 h/D, > 4 h/D). They found that sperm count, motility, viability, and percent normal morphology all decreased with increased cell phone use. (Agarwal et al., 2008)

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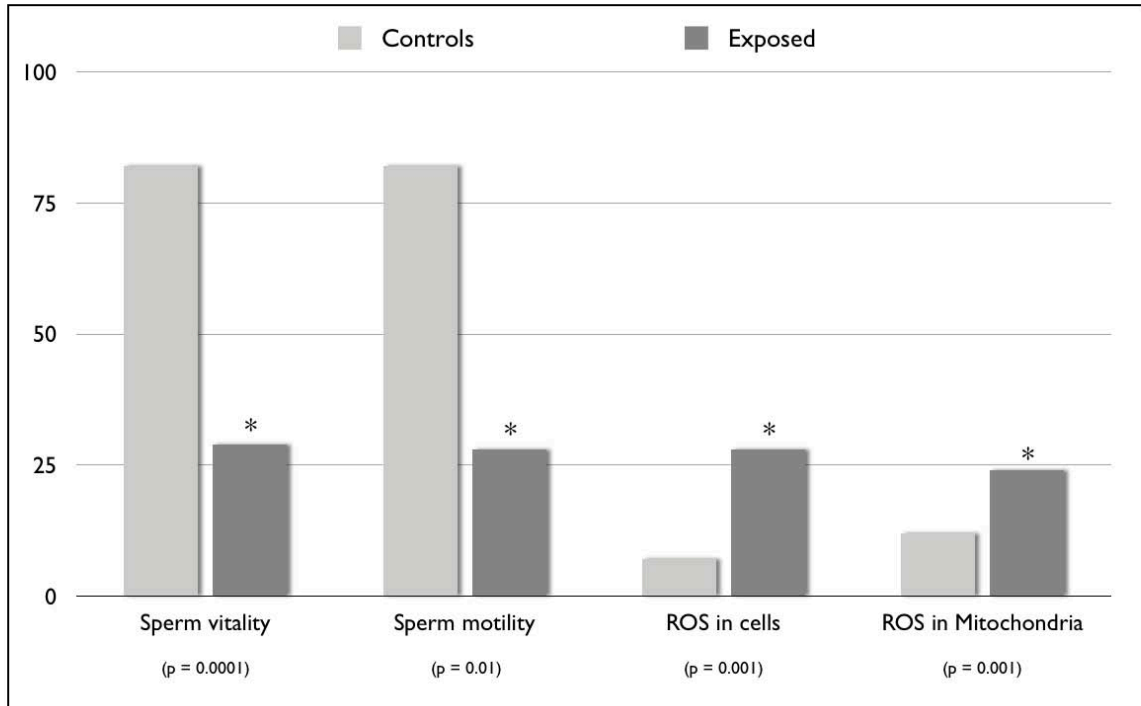


Figure 11: Sperm exposed in vitro to 1.8 GHz (SAR = 27.5 W/kg) for 16 hours @ 21°C (isothermal conditions). (De Iuliis et al., 2009)

De Iuliis et. al. exposed human sperm to 1.8 GHz microwave radio transmissions. Statistically significant decreases in sperm motility and vitality were demonstrate at exposure levels as low as 1.0 W/kg ($p < 0.01$). This study also found an increase in reactive oxygen species, oxidative damage to DNA, and DNA fragmentation, that was not dependent on thermal effects. (De Iuliis et al., 2009)

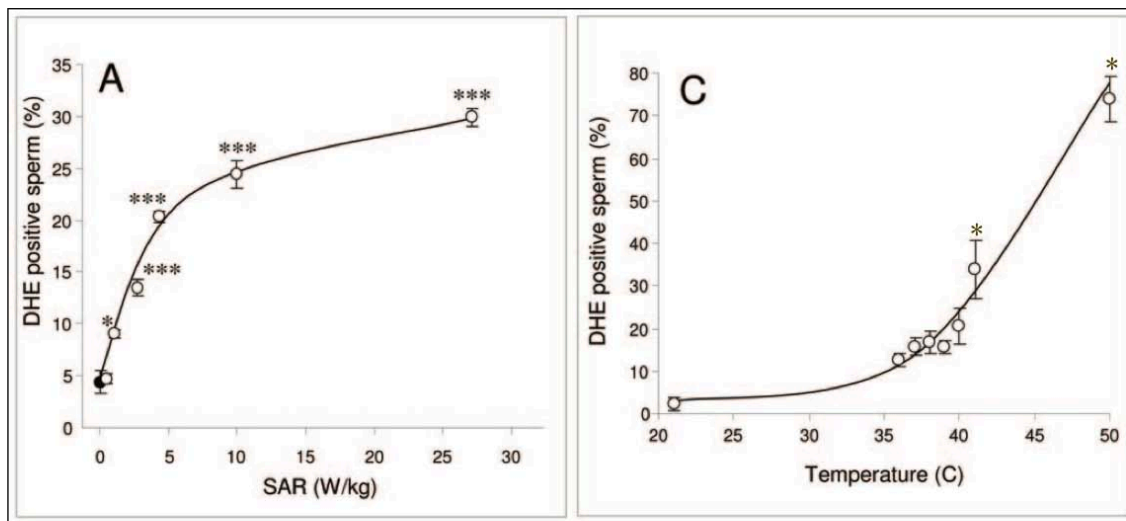


Figure 12: A) Production of ROS with increasing levels of microwave RF .
B) Production of ROS with increasing levels of temperature.
(De Iuliis et al., 2009)

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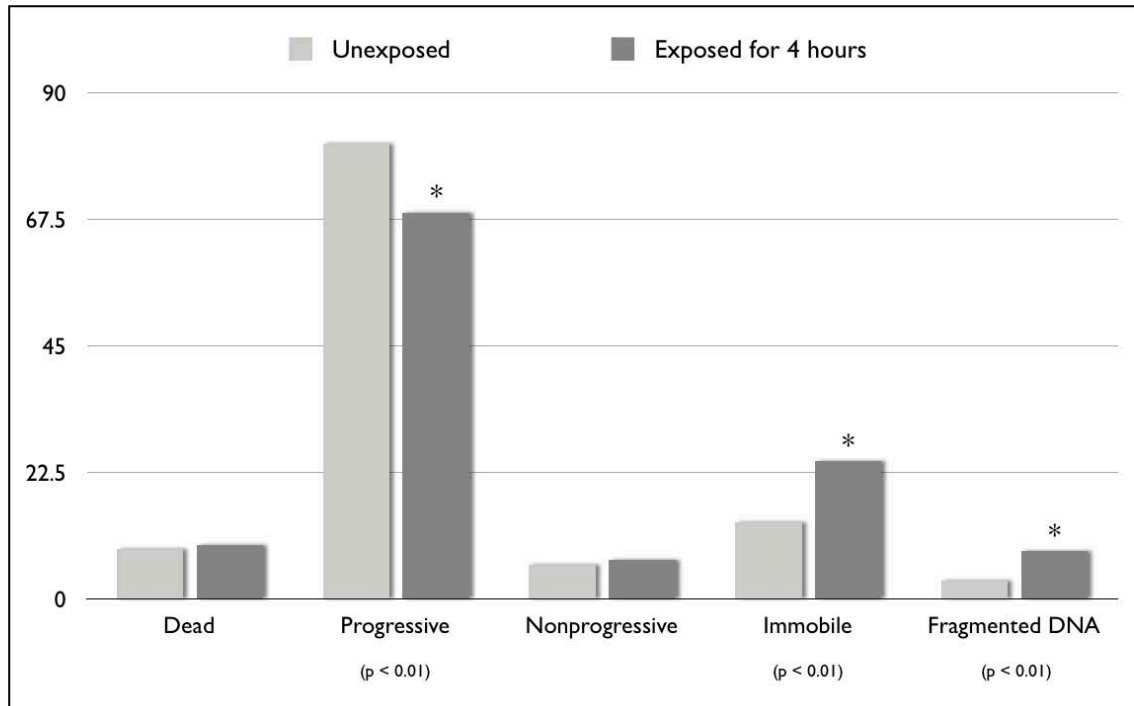


Figure 13: Sperm damage from exposure to laptop computer WiFi transmission.
(Avendano et al., 2011).

Another recent study the effects of exposing motile sperm to 4 hours of WiFi transmission at a position 3 cm beneath a laptop computer, at power densities between 0.45 and 1.05 $\mu\text{W}/\text{cm}^2$. Temperature was maintained at a constant 25°C. Exposed specimens showed a statistically significant decrease in sperm progressive motility, and a significant increase in non-motile sperm and in sperm DNA fragmentation. (Avendano et al., 2011)

The fact that multiple recent studies have demonstrated the ability of microwave RF exposure to cause nonthermal damage sperm function and sperm DNA with short exposure times and quite low exposure levels—the FCC exposure limit is 1000 $\mu\text{W}/\text{cm}^2$ —should be a source of grave concern. The presence of constantly transmitting WiFi networks in homes and schools may be much less innocuous than is generally supposed.

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CURRENT RESEARCH ON CELL PHONE USE AND BRAIN TUMOR RISK

INTRODUCTION

To be complete, any review of the health hazards of microwave radio exposures must include a discussion of the research on possible associations between cell phone usage and brain tumors.

This research is a hot topic politically. Cell phone use has permeated our society, and no one wants to think that use of a cell phone is going to increase their personal risk (or their child's personal risk) of acquiring a terrifying disease.

The rollout of the cellular communications infrastructure has also created an extremely profitable industry. The telecommunications industry made \$3.1 trillion in gross profits in 2010. (Plunkett Research, 2012) This industry has a powerful incentive to downplay the health effects of EMF, and has funded a good deal of research that serves to further that aim. Some studies regarding cell phones and brain tumors have been funded in large part by the telecommunications industry. These industry-designed studies have generally concluded that the use of cell phones does not create a health hazard. And these negative reports have received wide coverage in the news media. However, the study designs funded by industry are more likely to use unblinded protocols and to underestimate risk, as compared to studies funded by public bodies. (Levis et al., 2012)

When powerful financial interests are at play, industry funding of favorable research studies is often used to influence the political and scientific playing field. We've seen this play out in pharmaceutical research, where several recent scandals have highlighted the distorting effects of corporate financing on research outcomes. In the past few decades the production of research providing favorable (to corporate interests) results has become something of a science in itself, with corporations essentially gaming the academic system, funding studies designed to produce favorable outcomes for their products, and hiding studies that do not support their interests. The peer review process of the scientific journals has not proved to be an adequate defence against this problem. (Smith, 2005)

In the research on cell phones and brain tumors, the situation is further confounded by the fact that cell phone usage has only become wide spread in the last 15 years or so. The first digital cell phone infrastructure was pioneered in Scandinavia, and the first research that raised concerns about cell phone cancer risks was produced in Sweden in the late 1990's. But environmental influences that promote cancer generally take years to do so.

Take the question of the potential risk of cell phone use by teenagers. Does this cell phone use increase the risk of brain tumors later in life? The mass market for cell phone use by teenagers really started after 1995, and extended use of cell phones to surf the web ballooned after the introduction of the iPhone in 2007. Looking for brain cancer today in 30 year olds who started using a cell phone in 1997 would be similar to looking for lung cancer today in 30 year olds who started smoking in 1997 (and who would be most likely to develop lung cancer in their 50's or 60's).

This means we cannot find great reassurance in "negative" cell phone cancer risk studies performed 8 or 10 years ago. And similarly, any "positive" findings of cell phone cancer risk to date should produce real concern, since it is possible that they are identifying only the early cases of a larger problem.

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Three major and ongoing research studies have been performed in the last 10 years. One is the INTERPHONE Study, which is funded in major part by the telecommunications industry. A second study which received much recent media attention is the “Danish Cohort” study. A third body of research has been produced by the Hardell group in Sweden, a research group with no financial support from the telecommunications industry.

THE INTERPHONE STUDY

The INTERPHONE Study is a large standard protocol study of brain and salivary gland tumor risk in relation to mobile telephone use, with branches of the study being performed in 13 countries, and combined together to increase the statistical power of the results. This study was funded in major part by the wireless communications industry.

The first major summary of this research was published in 2010. This “case-control” study looked at patients with brain tumors (2708 glioma cases, 2409 meningioma cases) and matched controls, and compared their estimated cell phone usage to determine if regular cell phone usage increased the odds of being a brain tumor patient. The authors concluded that “Overall, no increase in risk of either glioma or meningioma was observed in association with use of mobile phones.” (Group, 2010)

This reported result was then widely quoted by the press and government agencies like the World Health Organization (IARC, 2010) as demonstrating the lack of risk of wireless technology.

However, this study defined a member of the risk group as any subject who “*had an average of at least one call per week for a period of 6 months*”. This definition of “regular cell phone use” diluted the risk pool out with lower risk individuals to the point that no difference between risk and control groups was visible in the study.

Interestingly, the study did report its statistics stratified by total time of reported use, and the top decile (greater than 1640 hours use over a ten year interval, averaging out as greater than 3 hours a week) had an increased risk of certain tumors. Individuals who accrued that greater than 1650 hours of use over a 1 to 4 year interval (ranging from 8 to over 30 hours a week) had a markedly higher odds ratio of meningioma (OR 4.80) or glioma (OR 3.27).

In the discussion of their data showing increased risk within the higher usage group, the authors failed to consider the possibility that this data showed a real risk. Instead, they discounted this trend of increased risk in the heavier users, stating that various “biases and errors limit the strength of the conclusions we can draw from these analyses and prevent a causal interpretation.” And it is this “biases and error’s” comment that has been quoted by industry apologists in subsequent publications, rather than the study’s actual statistical findings of increased odds of brain tumor with cell phone talk time greater than 3 hours a week over a ten year period, or greater than 8 hours a week over a 1 to 4 year period.

The discrepancy between actual data and concluding discussion in this study was not highlighted by mass media coverage of this study. One must assume that reporters read the abstract rather than the complete article, and accepted the author’s conclusions without question. Other researchers in the field were more critical in their assessments of the INTERPHONE project as compared to other published literature on the subject (Morgan, 2009), and pointed out that the INTERPHONE data really did

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document an increased risk, consistent with studies published by researchers in the field that were more independent from industry funding sources. (Hardell et al., 2011a) (Levis et al., 2011)

A more recent study from the INTERPHONE group found an increased risk for acoustic neuroma in individuals with > 1640 hours of talk time over up to 5 years of exposure (OR = 2.79, 95% CI = 1.51 – 5.16). For those subjects who routinely used their cell phone on the same side of the head where they had the acoustic neuroma, the odds ratio was 3.74 (95% CI 1.58 – 8.83). (Cardis and Schüz, 2011)

The most recent study from the INTERPHONE group showed increased odds ratio of glioma and meningioma with greater than 10 years of mobile phone use. The author's conclusions acknowledged this finding, but stated that "the uncertainty of these results requires that they be replicated before a causal interpretation can be made". This is an interesting comment, considering that this study result itself was essentially a replication of the actual findings of the earlier INTERPHONE study. (Cardis et al., 2011)

THE DANISH STUDY

A study from Denmark on the risk of mobile phones and brain tumors was published in the British Medical Journal in 2011. The conclusions of this study were that "there were no increased risks of tumors of the central nervous system, providing little evidence for a causal association". (Frei et al., 2011)

This study was widely quoted in the media and by government organizations as refuting the link between cell phones and brain tumors, with headlines like BBC News: "Mobile phone brain cancer link rejected." (Triggle, 2011)

In this case-control study, the risk group was composed of native Danes who had acquired a cell phone contract prior to 1995. However, any prior to 1995 corporate users were excluded from the risk group (this was 32% of the original cohort). Also excluded were all prior to 1995 subscribers who were less than 18 years old at the time they obtained their first subscription. The study did not determine how often members of the risk group used their phones, or make any determination as to exposure to portable phones in the home for risk or control group members.

The control group was composed of all Danes aged 30 or older and born after 1925 in Denmark. This of course means that the control group included all the early corporate subscribers (whom we might call the "power users"), and also included the 85% of Danes who obtained a cell phone *after* 1995.

This contamination of the control group with large numbers of cell phone users made the conclusions of the study essentially meaningless. To the BMJ's credit, letters that pointed this out were printed in the same issue with the original article (but apparently not read by the members of the press). (Khurana, 2011) (Philips and Lamburn, 2011)

The net result of all this was that the public was falsely reassured by media reports of a peer reviewed article in a prestigious medical journal, when the negative conclusions of that article were essentially meaningless. (Soderqvist et al., 2012)

THE HARDELL GROUP STUDIES

The first digital cell phone network (2G) was launched in Finland in 1991, and the cell phone communication infrastructure expanded widely in Scandinavia during that decade. In the late 1990's case reports of brain tumors in cell phone users lead to

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the first of multiple studies produced by the Hardell research group in Sweden. In this case control study of data collected between 1994 and 1996 from 233 living patients with biopsy-verified brain tumors, no clear distinction could be established between cell phone users and nonusers in the patient population, but a trend was observed of increased odds of tumor presence in the temporal or occipital lobe on the same side of the head habitually used to listen to the cell phone. (Hardell et al., 1999)

In 2002 Hardell et al. published another and larger case control study of 649 brain tumor cases diagnosed between January 1997 and June 2000. This study (and subsequent studies by the Hardell group) looked at exposure from both cellular phones and mobile (cordless) phones connected to land lines. Cumulative hours of cell phone use was calculated from questionnaires about phone usage habits. Increased risk of brain tumor was found for ipsilateral use (phone habitually on same side of head as brain tumor site) with both analogue and digital cellular phones and for cordless phones. Increased risk was also seen for increased duration of exposure. (Hardell et al., 2002)

Another expanded case control study with 1617 brain tumor patients diagnosed between 1997 and 2000 was published later that year showed similar findings, with the highest calculated risk being for ipsilateral acoustic neuroma in analog cellular phone users (the older technology). (Hardell et al., 2002)

Hardell et al. analyzed this same data set of 1617 patients for incidence of vestibular schwannoma (VS), and found an increased odds ratio for VS associated with the use of analogue cell phones. They found that the incidence of VS in Sweden had significantly increased during the time period from 1960 to 1998, with more of this increase occurring during from 1980 to 1998. All other brain tumors taken together had also showed a significant yearly increase between 1960 and 1998. (Hardell et al., 2003) (Hardell et al., 2003)

In 2006 and 2007, Hardell et al. published several more studies of brain tumor patients diagnosed between 1997 and 2003. Cell phones had been in wide use for a longer interval of time, and their data allowed evaluation of latency periods of > 10 years duration, and risk for subjects with first cell phone use at < 20 years of age. Cumulative lifetime use of > 2,000 hours showed elevated odds ratios for analog, digital, and cordless phones, and increased risk for malignant tumors with ipsilateral exposure. Risk of malignant tumors was more pronounced in individuals with first cell phone use at less than 20 years of age. (Hardell et al., 2006) (Hardell et al., 2006a) (Hardell et al., 2006b) (Mild et al., 2007)

Later in 2006, Hardell et al. published a pooled review of their data from all six of their previous case control studies. (Hardell et al., 2006) And they have subsequently published three more papers updating and consolidating their earlier findings. (Hardell and Carlberg, 2009) (Hardell et al., 2010) (Hardell et al., 2011b)

CRITIQUES AND REVIEWS

In 2004 Kundi et al. published a review of 9 existing epidemiologic studies on the relationship between cell phone use and brain tumor risk, and found that all studies approaching reasonable latencies of exposure time showed an increased relative risk (range 1.3 to 4.6) of brain tumor in cell phone users, with highest overall risk for acoustic neuroma (RR 3.5) and uveal melanoma (RR 4.2) (Kundi et al., 2004)

In 2007 Hardell et al. published a meta-analysis of two cohort studies and 15 case

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control studies on the association between long-term use of cell phones and brain tumor. They found increased risk for acoustic neuroma and glioma with ≥ 10 years of exposure, with higher risk of tumor on the exposed side of the head. (Hardell et al., 2007a)

Hardell, Mild, and Kundi published exhaustive reviews of the existing literature on this subject in 2007 in the Bioinitiative Report. (Hardell et al., 2007b) (Kundi, 2007)

In 2008, Hardell et al. published two meta-analyses of the existing case control studies in the literature including ten studies on glioma and nine studies on acoustic neuroma. They found “a consistent pattern of association between mobile phone use and ipsilateral glioma and acoustic neuroma using ≥ 10 years latency period”. (Hardell et al., 2008)

In another meta-analysis published in 2009, Hardell et al. again found “a consistent pattern of an increased risk for glioma and acoustic neuroma after > 10 year mobile phone use . . . with highest risk found in the age group < 20 years at time of first use of wireless phones.” (Hardell et al., 2009)

In a 2009 review, Ahlbom et al. stated that existing studies “do not demonstrate an increased risk within approximately 10 years of use for any tumor of the brain”. In a way, this statement is a somewhat backhanded acknowledgement of the fact that the published research to that date clearly does show increased risk with greater than 10 years of use. (Ahlbom et al., 2009)

In 2009 Khurana et al. published a metanalysis of the eleven existing long-term epidemiologic studies on cell phone use and brain tumor risk that met these criteria: Publication in a peer reviewed journal; inclusion of subjects with greater than 10 years of cell phone use; analyzing “laterality” of cell phone usage in relation to brain tumor incidence. Their conclusion was that “using a cell phone for ≥ 10 years approximately doubles the risk of being diagnosed with a brain tumor on the same (“ipsilateral”) side of the head as that preferred for cell phone use”. (Khurana et al., 2009)

In 2011 the WHO/International Agency for Research on Cancer (IARC) classified radiofrequency electromagnetic fields as “possibly carcinogenic to humans (Group 2B), based on an increased risk for glioma, a malignant type of brain cancer, associated with wireless phone use”. (WHO, 2011) (Baan et al., 2011)

In 2012, Levis et al. published an analysis of published case control studies, pooled analyses, and meta-analyses on head tumor risk with mobile phone use. They found that “in studies funded by public bodies, blind protocols give positive results revealing cause-effect relationships between long-term latency or use of mobile phones (cellulars and cordless) and statistically significant increases of ipsilateral risk of brain gliomas and acoustic neuromas, with biological plausibility. In studies funded or co-funded by the cellphone companies non-blind protocols give overall negative results with systematic underestimation of risk; however, also in these studies a statistically significant increase in risk of ipsilateral brain gliomas, acoustic neuromas, and parotid gland tumours is quite common when only subjects with at least 10 years of latency or exposure to mobile phones (only cellulars) are considered.” (Levis et al., 2012)

CONCLUSIONS

The current epidemiological research shows that greater than 10 years of cell phone use incurs a significantly increased risk of ipsilateral brain tumor (glioma or meningioma). This risk is greater in individuals that start using cell phones as children.

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This means that the RF exposure guidelines for cell phone use cannot be considered to be adequately protecting the public.

In light of these findings, current public policy that essentially ignores biological or “nonthermal” levels of RF exposure need to be reconsidered and revised, in order to significantly reduce the risk to the public health that is produced by these technologies.

SECTION 5 – CELL PHONE USE AND BRAIN TUMOR RISK

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CONCLUSIONS AND RECOMMENDATIONS

ADVERSE BIOLOGICAL EFFECTS—THE SCIENTIFIC EVIDENCE

In the previous sections we have reviewed the increasingly robust body of scientific evidence that excessive RF exposure can cause both acute and chronic adverse biological effects:

ACUTE EFFECTS

In susceptible individuals, excessive RF exposure can provoke acute symptoms. The most common symptoms are sleep disturbance, headache, irritability, fatigue, and concentration difficulties. Other symptoms may include depression, dizziness, tinnitus, burning and flushed skin, digestive disturbance, tremor, and cardiac irregularities.

As physicians, some of us have seen patients who are experiencing this problem, and are aware of the connection with RF exposure. Research suggests that 3 to 5% of the population fit into this category. If this is the case, there may be 4,700 people in Eugene who react to RF exposure in some way, and know it.

These symptoms are not uncommon in the population, of course. And in all probability there are many other people in Eugene who are having problems with insomnia or fatigue--problems provoked by EMF exposures--but are unaware of the connection between cause and effect.

Any significant increase in RF exposure in our residential areas will make these individuals more symptomatic. Such increases are likely to push additional individuals above their tolerance threshold, producing new cases of these problems. If increased RF levels from repeated daily transmissions between smart meters and their control towers pushed an additional 1% of the community into acute reactivity to RF exposures, this would mean an additional 1500 people in our city with insomnia, headaches, fatigue, ringing in the ears, or other debilitating symptoms.

CHRONIC EFFECTS

Chronic exposure to RF can also cause chronic physiologic changes, including altered endocrine function (both melatonin and other hormones), and increased oxidant stress that can lead to increased levels of cancer and male infertility. The public is already being subjected to increased levels of RF from wireless communications. Increasing the total load of transmission further will increase the occurrence of these adverse consequences.

PERSPECTIVE AS WE MOVE FORWARD

At the beginning of the last century, people began to use vehicles powered by internal combustion engines that burned gasoline. Gasoline power was cheap and convenient, and greatly increased the mobility of the population. And the companies that sold the gas and the cars made a lot of money.

This use of fossil fuels has had long term consequences--increased atmospheric CO₂ which through the greenhouse effect would lead to global climate change. Initially, these consequences went unrecognized. Then the scientific community began to predict and measure them.

Public acknowledgement of these consequences has gone through several stages. First, the science was ignored. Then the science was attacked or denied by those whose economic interests were threatened by it. Public recognition of the problem is only arriving as the long term consequences of climate change are beginning to be felt.

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The use of wireless communications technology is following a similar trajectory. Wireless communication is convenient, and increases our mobility. The installation of wireless networks is also significantly cheaper than installation of hard-wired networks. And the companies that provide these networks and the tools that we use to access them are making a great deal of money.

For decades, the biological consequences of this form of communication went unrecognized by both the public and the scientific community. As scientific evidence of biological and health effects began to emerge, this evidence was initially ignored by government regulating bodies, the media, and the public. As this evidence is getting harder to ignore, it is now being attacked or denied by the telecommunications industry. Wide public recognition of the problem and the science that describes it will arrive as the problem becomes more severe, and more people get sick.

The previous sections of this report describe the increasing body of science that clearly demonstrates the existence of adverse biological effects from chronic RF exposure. It is important for EWEB's Board and staff to recognize that this science is real, and that the science isn't going to go away. As the wireless communications infrastructure continues to grow, the magnitude and duration of public exposure are going to continue to increase, and the number of people with acute or chronic effects from this exposure will continue to grow. As recognition of the problem by the public increases, exposures and infrastructure that are currently unquestioned will become politically unacceptable.

EWEB has moved slowly in the process of investigating AMI technology. Recognition of the potential health effects of excessive RF exposure to the public should cause this appraisal to become even more deliberate and circumspect. EWEB needs to avoid investing millions of dollars on infrastructure that becomes part of the problem. Instead, EWEB needs to think about making engineering choices that recognize this problem, and seek to become a part of its solution.

RECOMMENDATIONS**BASIC PRECEPTS FOR RESIDENTIAL EXPOSURES TO RF TRANSMISSIONS**

- Excessive RF exposure can cause acute problems (headaches, insomnia, fatigue, vertigo, tinnitus, other symptoms of EHS).
- Excessive RF exposure can also cause chronic problems (oxidative stress, cancer, male infertility).
- Constant RF transmission is probably harmful, even at low levels, and should be avoided.
- Frequent and repetitive intermittent transmissions are also probably harmful, and should be avoided.
- Nocturnal exposures are more problematic than daytime exposures, because of RF's potential to suppress nocturnal melatonin secretion and disturb sleep, and because night is the time when we rest and heal from stresses (including oxidative stress).
- Occasional and infrequent daytime exposures are much less likely to cause an increase in chronic problems for the population at large.
- Occasional and infrequent daytime exposures are still likely to provoke acute symptoms in a small percentage of the population.

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Based on our review of the existing science, we suggest that the above basic precepts be considered when thinking about residential exposures to microwave RF transmissions. We consider this to be important for the population at large, and even more important for those in our community who suffer from symptoms of electrohypersensitivity. For all of us, our homes are the place where we rest and where we sleep, where we rejuvenate ourselves from the stresses of the wider world. It is important that our residential environments be a place where this can occur. Our homes need to be part of the solution, not part of the problem.

EWEB SHOULD ADOPT A POLICY OF MINIMIZING THEIR RF FOOTPRINT IN THE COMMUNITY

A recognition of these precepts should lead EWEB to adopting a policy of minimizing their infrastructure's RF footprint in the community as much as possible during regular operations. This doesn't mean that staff would throw away their cell phones and communicate by semaphore. But it would mean that instead of combatting or ignoring the possibility that more RF in the community could cause harm, EWEB should acknowledge the potential risks of excessive residential exposure.

This would mean that such potential risks would be seriously considered in any discussion of the total risks and benefits (the "Total Bottom Line") in deciding whether to use RF technology for any given purpose. If, after such a discussion, a considered decision is made to use RF technology, then these same potential risks should be taken into serious consideration in determining how to use this technology in a manner that would minimize potential harm to the community.

In other words, don't use RF when you don't have to. Go hard-wired wherever it is feasible to do so. And if you do use RF, design the technology to use as little of it as possible.

Current engineering choices in AMI technology have not been designed with these goals in mind, since the industry has not had an practical incentive to recognize the problem and to "work the problem". But EWEB as a purchaser of technology could choose to push vendors towards designing and providing hardware options that would address these goals. This would put EWEB in the position of being part of the solution rather than just another part of the problem.

FLAWS IN THE CONCEPT OF "OPTING OUT"

It has been suggested that people who have problems with EHS or concerns about health exposures to RF can be taken care of by creating an "opt out" program, allowing them to decline the installation of a smart meter on their home. This suggestion overlooks some obvious and important problems:

- You can't "opt out" of exposure to your neighbor's meter, that is ten feet away from your bedroom window.
- You can't "opt out" of all the meters on the wall of your rental apartment complex. Or the ones on the wall of the complex right across the alley from your apartment.
- You can't "opt out" of exposure to the meter on the other side of your bedroom wall if you are a baby in a crib.
- You can't "opt out" of exposure to transmissions from the radio tower 100 meters from your house.

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The idea of an “opt out” program is an effort to address the concerns of people who are personally worried about RF exposures, either because they are aware of having acute reactions to these exposures, or because they have a general concern about the acute or chronic effects from such exposure.

But a voluntary “opt out” program does not protect the community at large from adverse effects that they are unaware of and unconcerned about. For example, the current research shows that cancer rates are higher in residences near cellular transmission towers. Most people don’t know this. How does a voluntary “opt out” program help the person who develops breast cancer three years after installation of a transmission tower across the street from her house? She didn’t know it was a problem . . .

DISCUSSION OF THE TECHNOLOGY OPTIONS

How would adopting these precepts and goals play out in practice? Several factors come into consideration:

- The scientific evidence on biological effects of RF, summarized in the basic precepts listed above.
- The various possible functional goals of the AMI program:
 - Reducing operating costs by reading and switching meters remotely.
 - Training customers to conserve electricity.
 - Shifting time of use by measuring and billing time of day usage.
 - Absorbing fluctuations in renewable energy supply by “demand/response” control of usage.
- The different AMI technologies that are available.

When our committee puts our best understanding of these three factors into consideration, and look at each choice in AMI technology through this combined frame of reference, the discussion runs something like this:

MESH Network

From a biological point of view, AMI meters that are transmitting several times a minute can be considered to be an essentially constant source of RF exposure. Where these networks have been established in the last two years, large increases in reported acute symptoms have occurred. We think it is medically probable that that this technology will be found to cause an increase in chronic health problems, including increased cancer, once sufficient time has passed for this to occur.

EWEB staff has already explored and tested a MESH option and chosen not to go forward on that path. We applaud EWEB’s decision to steer away from this technology.

Powerline Communications (PLC)

From a public health point of view, PLC is less problematic than an RF AMI communication technology. And PLC could be used to reduce operating costs, train customers to conserve electricity using in-house monitors, and record and transmit time of day usage measurements to the utility.

EWEB has turned away from the choice of PLC for two main reasons. Firstly, because it won’t allow measurement of water meter readings, limiting the reduction of operating costs from elimination of meter reading. Secondly, because PLC as currently designed does not have the bandwidth to sustain rapid “demand/response” control communications.

There are some other technical considerations that make PLC infrastructure more awkward to set up in an environment where some transmission wires are on poles and

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others are underground.

If “demand/response” was not on the table, and if a Total Bottom Line analysis of the options included the potential health costs of using RF technology, the financial analysis of the PLC option might look different than it did in the AMI Business Case prepared by EWEB staff last April. A decision to read the water meters once every 3 months rather than monthly could also realize additional savings, if this option was under serious consideration.

Fiber Optic Communications

Fiber optic communication between the utility and the house meter is an ideal solution from a health/environmental point of view, providing ample bandwidth without RF transmission. However, this technology would be quite expensive to install, especially in the parts of Eugene where the power grid is underground. The cost might be prohibitive for EWEB at this point in time. Like PLC, fiber optics would not communicate with the water meters.

Tower Communications Network (SENSUS)

The engineering system that EWEB is currently considering is the SENSUS company’s technology, where central towers communicate directly with the meters on the houses. SENSUS owns the sole rights to a certain transmission frequency on the communications bandwidth. This allows them to use more powerful radios on the smart meters, strong enough to communicate directly with a transmission tower without requiring that the message be passed from meter to meter across a MESH network. The community would be divided into about 13 zones, each of which would have a communication tower placed on an existing EWEB property within the zone, and these towers would communicate directly with the house electric meters and with radios on the house water meters.

With 88,000 electric meters and 52,000 water meters in the city, an average zone would have 6770 electric meters and 4000 water meters in the zone. How long a transmission interval would be required for a tower to collect the data from 10,770 meters? We don’t know the answer to this question, and EWEB engineers may not know either, until they set up a trial system and test it out. But clearly, the RF footprint created by this sort of system could vary significantly, depending on how the system was used.

It is routine for utilities to collect data from these systems four times a day. But this routine was developed without consideration of the potential health risks of excessive RF transmission in the community. And usage data does not need to be collected this frequently to achieve the main goals of the AMI program. From a practical point of view, the utility will continue to bill once a month, and in theory could remotely collect that usage data once a month, minimizing the community’s exposure to frequent and repetitive RF transmissions.

We think usage data should be collected from these meters at an interval of once every two to four weeks, with transmission occurring during the daytime hours. Transmission events at this level of infrequency would represent a minimal increase in the RF exposure to the community, and would be unlikely to significantly increase the risk of chronic health problems in the community.

Each data transmission event would still be likely to provoke acute symptoms in individuals with EHS who lived near these transmission towers. But if these events occurred at an interval of once every two weeks or longer, and at a predictable time of

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day, this might be a manageable level of exposure for those individuals.

In our informal discussions with EWEB engineers, we have been told that they have looked into the issue of data collection frequency, and that the longest that they could go between data collection events with the SENSUS system would be about three and one half days.

This would appear to be a case where the technology has not been designed with an eye to minimizing RF transmission. Six daily time-of-use intervals times 30 days equals 180 intervals of usage data. We think that if an iPod can store 64 gigabytes of music, it ought to be possible to give a smart meter enough memory to store 180 readings before transmitting them to the utility. We would recommend that EWEB ask their potential vendors to provide a meter with enough memory to store two to four weeks of data, to enable the minimal RF footprint that we are recommending.

Tower communications and the water meters

Water usage is billed once a month, and a single monthly reading of the meters would collect this data with minimal RF exposure to the community. Again, this data collection should occur in the day time, not in the middle of the night.

Tower communications and “demand/response”

From a public health perspective, the use of the system for “demand/response” load control is more problematic. As we understand it, a lot of this transmission would occur at night, when wind power production is high and demand is low. Towers would be transmitting every 15 minutes, to turn one cohort of water heaters on and another cohort off. And the protocols required by the grid would require a two way communication with each meter in the cohort, acknowledging that house’s participation in the cohort at that time.

This will involve a good deal of transmission in the system every 15 minutes, both from the towers potentially talking to hundreds of meters across the neighborhood, and from the 2 watt radios on each house in the cohort talking back to the tower.

Communication of this frequency from the towers would be a significant additional layer of frequent nocturnal RF signal exposure to the residences within a few hundred meters of the towers.

And enough cohorts of houses are involved, the transmissions from the meters on the houses could also increase the signal density in the residential areas enough to disrupt melatonin and sleep in a percentage of the population.

We think that this frequent level of activity in the demand/response system would be a significant additional RF burden on the community. It would make life in the residential area significantly more difficult for those individuals in the community that is currently already having acute problems. It would probably cause the onset of acute symptoms in a small percentage of the population who are not currently experiencing them. And it would be likely to further increase the incidence of chronic adverse RF effects in our community.

Demand/response and the in-home “Zigbee” network

Once the AMI smart meter on the house gets a demand/response signal from the control tower, it must tell the water heater in the house to turn on. Existing technology does this through wireless communication over a “Zigbee” WiFi network in the home. This network is maintained by constant transmissions of signals between the meter and the Zigbee appliances in the home network, 24 hours a day.

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The research that we've reviewed above shows that biological effects can be produced by low power levels of RF exposure, and that prolonged, constant exposures can have effects even at extremely low exposure levels.

For demand/response to work in the community, at least 20% of the homes in the community will need to volunteer for the program, and have it set up in their houses. In undertaking to install demand/response infrastructure in its current form, EWEB would be making several presumptions:

- A presumption that the Zigbee system is low enough in power that it won't cause any harm.
- A presumption that public acceptance should be good, since the public at large isn't really concerned about the health effects of RF at this time.
- A presumption that since most people have WiFi now anyway, they aren't going to be concerned about the additional exposure.
- A presumption that because the system will be voluntary, so no one can or will complain about involuntary exposure.

While it may be true that the public isn't that worried at present, and that many people have WiFi in their homes and aren't worried about it at all, we do not think that EWEB can assume that this will continue to be the case throughout the investment lifetime of the installed demand/response infrastructure.

As we've discussed in the prior sections, signals of WiFi power are strong enough to cause severe symptoms in individuals with EHS. Several hours of WiFi exposure has been shown to cause damage to healthy sperm. The general public is unaware of these facts. But we think that this is less likely to be the case 8 or 10 years from now, much less 20 years from now. As increased exposure to wireless RF communications causes more health problems in the population, and the scientific evidence of this effect continues to become more robust, public attitudes about this exposure are going to change. Within 20 years, the public—especially parents with young children—will be much less open to having constant WiFi signal in their homes. If this assumption is correct, the purchase of many millions of dollars in demand/response infrastructure that is based on wireless in-home communications would appear to be an unwise investment.

The “demand/response” infrastructure is still immature

We think that the “demand/response? infrastructure is still immature. This technology may be mature from an engineering point of view, in that “it works”. But from a public health perspective, it is completely immature. We state this because the technology has been designed around RF communications (because this infrastructure is quicker and cheaper to set up than a hard wired system) without any consideration of the health effects of exposure to excessive or prolonged RF transmissions, and without any considered effort to engineer the hardware or the software protocols in a way that would minimize such exposures.

The Zigbee network is a case in point. In modern construction, most electric meters are sitting on the outside of the circuit breaker box. Within that breaker box, there are dedicated circuits with hard-wired connections to the electric water heater, the electric stove, and the electric clothes drier.

Why not set up communications between these utilities with powerline communications protocols over these hard-wired connections? All it would take would be

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some intelligent technology in the 220 circuit breakers for the appliances, and a smart switch at the other end of the circuit, and connections to the network controls in the smart meter that is plugged into the breaker box. All this could be done without putting any RF transmission into the house?

Why hasn't this been done yet? Because a wireless solution is easier to install? Because changing the hard wiring would require changing electrical codes? Because no one thinks it's necessary to get this clever, since no one is worried about RF exposures?

Solutions like this could be created, if industry and government had enough incentive to work the problem, rather than to deny the existence of the problem. Until such alternatives to constant in-home RF exposure are developed, we think that EWEB would be wise to avoid getting married to this technology. Developing demand/response using a constantly transmitting in-home RF network will mean investing a great deal of money in infrastructure that is likely to become extremely unpopular within the next 10 to 15 years. What we look at now as "quick and cheap" will come to be viewed as "quick and dirty".

Other communication options

We've been told that the powerline communication option is not a feasible solution for demand/response control, since it lacks the bandwidth necessary for rapid communications between server and meters.

We think that serious consideration should be given to the potential use of broadband internet connections for demand/response communications. We understand that EWEB does not have the financial power to build their own fiberoptic network at this time. But in 2010, 82% of the households in our part of the state had broadband internet connections, and this proportion continues to grow. Would it be technically possible to use these wired internet connections to communicate with the vast majority of the electric meters in our city, rather than building a new wireless infrastructure to do the job? Broadband internet communications would certainly have the bandwidth to do this, and a demand/response system is not expected to require the participation of every household in the community. If we acknowledge the health risks of RF communication (especially the robust night-time communication expected for demand/response control), then an internet-based demand/response control system should be given serious consideration.

IN CONCLUSION

We hope that our report and recommendations will be helpful to EWEB staff, the EWEB Board of Governors, and to members of our community. We think that review of this information should allow a more realistic appraisal of the health risks involved in establishing an AMI network that utilizes microwave RF communication. Such a measured and realistic appraisal is a necessary part of the Total Bottom Line Analysis that EWEB has promised to bring to any major initiative in our community.

This is a lengthy document, and discusses complex issues. We would welcome the opportunity to meet with EWEB staff and members of the Board, in order to give a more extensive audiovisual presentation and clarification of this material, and to answer any questions that you wish to ask us about this research.

We hope to be part of an ongoing dialogue about the potential health effects of RF technology, as EWEB continues to deliberate on the various choices that they face with the AMI program.

The Biological Effects of Weak Electromagnetic Fields, Problems and
Solutions, Prof. Andrew Goldsworthy; 2012

The Biological Effects of Weak Electromagnetic Fields

Problems and solutions

Andrew Goldsworthy March 2012

Foreword

I am a retired lecturer from Imperial College London, which is among the top three UK universities after Oxford and Cambridge and is renowned for its expertise in electrical engineering and health matters. I spent many years studying calcium metabolism in living cells and also how cells, tissues and organisms are affected by electrical and electromagnetic fields.

In this article, I will try to explain in lay-person's language how weak electromagnetic fields from cell phones, cordless phones and WiFi can have serious effects on human and animal health. These include damage to glands resulting in obesity and related disorders, chronic fatigue, autism, increases in allergies and multiple chemical sensitivities, early dementia, DNA damage, loss of fertility and cancer.

All this happens at levels of radiation that the cell phone companies tell us are safe because the radiation is too weak to cause significant heating. **This is the only criterion that they use to assess safety.** In fact, the direct electrical effect on our cells, organs and tissues do far more damage to us at energy levels that may be hundreds or thousands of times lower than those that cause significant heating. These are termed non-thermal effects. As yet **our governments and health authorities are doing nothing to protect us from them.**

This need not be so. By understanding the mechanisms of these non-thermal effects, it is possible to put most of them right, as I will show in the following article.

Abstract

Many of the reported biological effects of non-ionising electromagnetic fields occur at levels too low to cause significant heating; i.e. they are non-thermal. Most of them can be accounted for by electrical effects on living cells and their membranes. The alternating fields generate alternating electric currents that flow through cells and tissues and remove structurally-important calcium ions from cell membranes, which then makes them leak.

Electromagnetically treated water (as generated by electronic water conditioners used to remove lime scale from plumbing) has similar effects, implying that the effects of the fields can also be carried in the bloodstream. Virtually all of the non-thermal effects of electromagnetic radiation can be accounted for by the leakage of cell membranes.

Most of them involve the inward leakage of free calcium ions down an enormous electrochemical gradient to affect calcium-sensitive enzyme systems. This is the normal mechanism by which cells sense mechanical membrane damage. They normally respond by triggering mechanisms that stimulate growth and repair, including the MAP-kinase cascades, which amplify the signal.

If the damage is not too severe or prolonged, we see a stimulation of growth and the effect seems beneficial, but if the exposure is prolonged, these mechanisms are overcome and the result is ultimately harmful. This phenomenon occurs with both ionising and non-ionising radiation and is called radiation hormesis. Gland cells are a good example of this, since short term exposures stimulate their activity but long term exposures cause visible damage and a loss of function. Damage to the thyroid gland from living within 100 metres of a cell phone base station caused hypothyroidism and may be partially responsible for our current outbreak of obesity and chronic fatigue.

Secondary effects of obesity include diabetes, gangrene, cardiac problems, renal failure and cancer. Cell phone base station radiation also affects the adrenal glands and stimulates the production of adrenalin and cortisol. Excess adrenalin causes headaches, cardiac arrhythmia, high blood pressure, tremors and an inability to sleep, all of which have been reported by people living close to base stations. The production of cortisol weakens the immune system and could make people living near base stations more susceptible to disease and cancer.

Inward calcium leakage in the neurons of the brain stimulates hyperactivity and makes it less able to concentrate on tasks, resulting in attention deficit hyperactivity disorder (ADHD). When this happens in the brains of unborn babies and young children, it reduces their ability to concentrate on learning social skills and can cause autism. Leakage of the cells of the peripheral nervous system in adults makes them send false signals to the brain, which results in the symptoms of electromagnetic intolerance (aka electromagnetic hypersensitivity). Some forms of electromagnetic intolerance may be due to cell phone damage to the parathyroid gland, which controls the calcium level in the blood and makes cell membranes more inclined to leak. Further exposure could then tip them over the edge into full symptoms of electromagnetic intolerance.

Cell phone radiation damages DNA indirectly, either by the leakage of digestive enzymes from lysosomes or the production of reactive oxygen species (ROS) from damaged mitochondrial and plasma membranes. The results are similar to those from exposure to gamma rays from a radioactive isotope.

Effects of DNA damage include an increased risk of cancer and a loss of fertility, both of which have been found in epidemiological studies. The effects of cell phone and WiFi radiation have also been determined experimentally using ejaculated semen. The results showed the production of ROS, and a loss of sperm quality and, in some cases, DNA fragmentation.

The inward leakage of calcium ions from electromagnetic fields also opens the various tight junction barriers in our bodies that normally protect us from allergens and toxins in the environment and prevent toxic materials in the bloodstream from entering sensitive parts of the body such as the brain. The opening of the blood-brain barrier has been shown to cause the death of neurons and can be expected to result in early dementia and Alzheimer's disease. The opening of the barrier in our respiratory epithelia by electromagnetic fields has been shown to increase the risk of asthma in children and the opening of the blood-liver barrier may be partially responsible for the current outbreak of liver disease. The opening of other barriers, such as the gut barrier allows foreign materials from the gut to enter the bloodstream, which may also promote allergies and has been linked autoimmune diseases.

Cell membranes also act as electrical insulators for the natural DC electric currents that they use to transmit power. Mitochondrial membranes use the flow of hydrogen ions to couple the oxidation of food to the production of ATP. The outer cell membrane uses the flow of sodium ions to couple the ATP produced to the uptake of nutrients. If either of these leak, or are permanently damaged, both of these processes will be compromised leading to a loss of

available energy, which some people believe to be a contributory factor to chronic fatigue syndrome.

The mechanism underlying electromagnetically-induced membrane leakage is that weak ELF currents flowing through tissues preferentially remove structurally important calcium ions, but they have been shown to do so only within certain amplitude windows, above and below which there is little or no effect. This means that there is no simple dose-response curve, which many people find confusing, but a plausible theoretical model is described. The mechanism also explains why certain frequencies especially 16Hz is particularly effective.

Living cells have evolved defence mechanisms against non-ionising radiation. These include pumping out surplus calcium that has leaked into the cytosol, the closure of gap junctions to isolate the damaged cell, the production of ornithine decarboxylase to stabilize DNA and the production of heat-shock proteins, which act as chaperones to protect important enzymes. However, this is expensive in energy and resources and leads to a loss of cellular efficiency. If the exposure to the radiation is prolonged or frequently repeated, any stimulation of growth caused by the initial ingress of calcium runs out of resources and growth and repair becomes inhibited. If the repairs fail, the cell may die or become permanently damaged.

To some degree, we can make our own electromagnetic environment safer by avoiding ELF electrical and magnetic fields and radio waves that have been pulsed or amplitude modulated at ELF frequencies. The ELF frequencies that give damaging biological effects, as measured by calcium release from brain slices and ornithine decarboxylase production in tissue cultures, lie between 6Hz and 600Hz. It is unfortunate that virtually all digital mobile telecommunications systems use pulses within this range. The Industry clearly did not do its homework before letting these technologies loose on the general public and this omission may already have cost many lives.

Even now, it may be possible reverse their effects by burying the pulses in random magnetic noise, as proposed by Litovitz in the 1990s or by cancelling out the pulses using balanced signal technology but, at present, the Industry does not seem to be interested in either of these.

Until the mobile telecommunications industry makes its products more biologically friendly, we have little alternative but to reduce our personal exposure as far as possible by using cell phones only in emergencies, avoiding DECT cordless phones and substituting WiFi with Ethernet . The only DECT phones that are even remotely acceptable are those that automatically switch off the base station between calls; e.g. the Siemens Gigaset C595 operating in Eco Plus mode. If you are highly electromagnetically intolerant, you may need to screen your home or at the very least your bed from incoming microwave radiation and sleep as far away as possible from known sources of ELF.

INTRODUCTION

There have been many instances of harmful effects of electromagnetic fields from cell phones (aka mobile phones), DECT phones (aka cordless phones), WiFi, power lines and domestic wiring. They include an increased risk of cancer, loss of fertility, effects on the brain and symptoms of electromagnetic intolerance. Many people still believe that, because the energy of the fields is too low to give significant heating, they cannot have any biological effect. However, the evidence that alternating electromagnetic fields can have non-thermal biological effects is now overwhelming. See www.bioinitiative.org and www.neilcherry.com . The explanation is that it is not a heating effect, but mainly an electrical effect on the fine structure of the electrically-charged cell membranes upon which all living cells depend.

Alternating electromagnetic fields can induce *alternating currents* to flow through living cells and tissues. These can interfere with the normal *direct currents* and voltages that are essential for the metabolism of all cells. Virtually every living cell is a seething mass of electric currents and electrical and biochemical amplifiers that are essential for their normal function. Some have tremendous amplifying capacity; e.g. it is claimed that a dark adapted human eye can detect a single photon (the smallest possible unit of light) and the human ear can hear sounds with energies as low as a billionth of a watt. We should therefore not be too surprised to find that our cells can detect and respond to electromagnetic fields that are orders of magnitude below the strength needed to generate significant heat.

My main objective here is to show how most of the adverse health effects of electromagnetic fields can be attributed to a single cause; that being that they remove structurally-important calcium ions (electrically-charged calcium atoms) from cell membranes, which then makes these membranes leak. I will explain the scientific evidence leading to this conclusion and also how we can put matters right, but still keep on using cell phones and other wireless communications. I have included key references that should enable the more inquisitive reader to delve deeper. In many cases, you should be able to find the abstract of the paper in question by copying into Google its entry in the list of references.

Electromagnetic fields affect many but not all people

Many of the experiments on the biological effects of alternating electromagnetic fields appear to give inconsistent results. There are many reasons for this, including differences in the genetic make-up, physiological condition and the history of the test material. In humans, reported effects include an increased risk of cancer, effects on brain function, loss of fertility, metabolic changes, fatigue, disruption of the immune system, and various symptoms of electromagnetic intolerance.

Not everyone is affected in the same way and some may not be affected at all. However, there is increasing evidence that the situation is getting worse. Our electromagnetic exposure is rapidly increasing and previously healthy people are now becoming sensitised to it. In this study, I am concentrating on the cases where there have been definite effects; since this is the most efficient way in which we can find out what is going wrong and what can be done to prevent it.

The frequency of the fields is important

The fields that give the most trouble are in the extremely low frequency range (ELF) and also radio frequencies that are pulsed or amplitude modulated by ELF. (Amplitude modulation is where the strength of a *carrier wave* transmits information by rising and falling in time with a lower frequency that carries the information.).

Why microwaves are particularly damaging

The frequency of the carrier wave is also important. Higher frequencies such as the microwaves used in cell phones, WiFi and DECT phones, are the most damaging. Our present exposure to man-made microwaves is about a million billion billion (one followed by eighteen zeros) times greater than our natural exposure to these frequencies. We did not evolve in this environment and we should not be too surprised to find that at least some people may not be genetically adapted to it. As with most populations faced with an environmental change, those members that are not adapted either become ill, die prematurely or fail to reproduce adequately. Ironically, those who are electromagnetically intolerant may be better equipped to survive since they are driven to do whatever they can to avoid the radiation.

The main reason why microwaves are especially damaging is probably because of the ease with which the currents that they generate penetrate cell membranes. Cell membranes have a very high resistance to direct currents but, because they are so thin (about 10nm), they behave like capacitors so that alternating currents pass through them easily. Since the effective resistance of a capacitor to alternating current (its *reactance*) is inversely proportional to its frequency, microwave currents pass through the membranes of cells and tissues more easily than radio waves of lower frequencies and can therefore do more damage to the cell contents.

Calcium loss from cell membranes explains most of the adverse health effects

I became interested in this topic when I was working on the biological effects of physically (magnetically) conditioned water, which is widely used to remove lime scale from boilers and plumbing. It is made by allowing tap water to flow rapidly between the poles of a powerful magnet or by exposing it to a weak pulsed electromagnetic field from an electronic water conditioner. Water treated in this way can remove calcium ions (electrically charged calcium atoms) from surfaces, and the effect on the water can last for several days. I was following up some Russian and Israeli work that had shown that magnetically conditioned water could increase the growth of crops, but it turned out to be far more important than that. The underlying principle was also to explain the mechanisms by which weak electromagnetic fields can damage living cells and also what can be done to stop it.

Magnetically conditioned water and electromagnetic fields have similar effects

Probably, our most important discovery was that when tap water was conditioned by weak electromagnetic fields, the treated water gave similar effects in yeast to those from exposing the yeast itself, amongst which was an increased permeability of their cell membranes to poisons (Goldsworthy *et al.* 1999). Since it had been known since the work of Bawin *et al.* (1975) that weak electromagnetic fields could remove calcium ions from the surfaces of brain cells, it seemed likely that both the conditioned water and the electromagnetic fields were working in the same way; i.e. **by removing structurally-important calcium ions from cell membranes, which then made them leak.** We now know that membrane leakage of this kind can explain most of the biological effects of both conditioned water and of direct exposure to electromagnetic fields.

The effects on growth depend on the length of the conditioning treatment

We also showed that the effects of conditioned water on the growth of yeast cultures depended on the length of the conditioning process. Less than 30 seconds of conditioning stimulated growth but more than this inhibited growth. It was as if the conditioning process was steadily generating one or more chemical agents in the water. A low dose from the shorter conditioning period stimulated growth, but longer conditioning periods gave higher doses, which were inhibitory. This toxic effect of heavily conditioned water, where the water is recycled continuously through the conditioner, has now been exploited commercially to poison blanket weed in ornamental ponds (www.lifescience.co.uk/domestic_blanketweed.htm). By the same token, blood continually circulating for prolonged periods under the pulsating fields from a cell phone or similar device could become toxic to the rest of the body. This means that no part of the body, from the brain to the liver and gonads, can be considered to be safe from the toxic effects of pulsed electromagnetic fields.

Radiation hormesis

Many people have shown similar dual effects with direct exposure to both *ionising and non-ionising radiation*. Small doses of otherwise harmful radiation often stimulate growth and appear to be beneficial (a phenomenon known as *radiation hormesis*) but larger doses are harmful. It also explains why small doses of pulsed magnetic fields are effective in treating some medical conditions such as broken bones (Bassett *et al.* 1974) but prolonged exposure (as we will see later) is harmful.

It also explains some of the apparent inconsistencies found when comparing different experiments and why meta-analysis of the data should be treated with caution. Clear positive and clear negative results (depending on the dose and the condition of the material) when taken together could be mistaken for no effect, but with a high degree of variability.

Cells have tremendous powers to amplify and respond to weak signals

We now know that electromagnetic growth stimulation is almost certainly due to electrochemical amplification followed by the activation of the MAP kinase cascades by free calcium ions leaking into the cytosol (the main part of the cell). The inward leakage of calcium ions is the normal mechanism by which a cell senses that it has been damaged and triggers the necessary repair mechanisms. This involves huge amplification processes so that even minor leakage (e.g. due to membrane perforation or weak electromagnetic fields) can give rapid and often massive responses.

The first stage in the amplification is due to the calcium gradient itself. There is an enormous (over a thousand fold) concentration difference for free calcium between the inside and outside of living cells. In addition, there is a voltage difference of many tens of mV acting in the same direction. This means that even a slight change in the leakiness of the cell membrane can permit a very large inflow of calcium ions. It's like a transistor, where a slight change in the charge in the base can allow a massive current to flow through it under the influence of a high voltage gradient between the emitter and collector.

The next stage in the amplification is due to the extremely low calcium concentration in the cytosol so that even a small ingress of calcium ions makes a big *percentage* difference, to which many enzymes within the cell are sensitive.

Even more amplification comes from the MAP-kinase cascades. These are biochemical amplifiers that enable tiny amounts of growth factors or hormones (perhaps even a single molecule) to give very large effects. They consist of chains of enzymes acting in sequence so that the first enzyme activates many molecules of the second enzyme, which in turn activates still more of the third enzyme etc. The final stage then activates the protein synthesising machinery needed for cell growth and repair.

At least some of these cascades need calcium ions to work (Cho *et al.* 1992) so the inward leakage of calcium through damaged cell membranes will increase the rate of these processes to stimulate growth and repair. However, these repairs can make deep inroads into the cell's energy and resources, and its ability to make good the damage will depend on its physiological and nutritional condition. This means that, if the damage is prolonged or persistent, sooner or later it runs out of resources and gives up, which is when we see the inhibitory phase, perhaps followed by apoptosis (cell death) or the loss of some of the cell's normal functions. We are now seeing this loss of function increasingly after prolonged human exposure to cell phone base station radiation; e.g. the loss of thyroid gland function after six years of exposure (Eskander *et al.* 2012).

Effects on Glands

Gland cells are particularly sensitive to radiation

Gland cells may be particularly sensitive to radiation because their secretions are normally produced in internal membrane systems, which can also be damaged. Their secretions are usually released in vesicles (bubbles of membrane) that fuse with the external cell membrane and disgorge their contents to the outside (exocytosis). The vesicle membrane then becomes part of the external membrane. The resulting excess external membrane is counterbalanced by the reverse process (endocytosis) in which the external membrane buds off vesicles to the inside of the cell, which then fuse with the internal membranes. In this way, an active gland cell may internalise the equivalent of its entire surface membrane about once every half an hour. This means that if the surface membrane is damaged directly by the fields, or by electromagnetically conditioned blood, the damaged membrane rapidly becomes part of the internal membrane system, upon which its normal activity depends. If the damage is too severe, the whole gland may lose its normal function.

Electromagnetic effects on the endocrine system and obesity

Although electromagnetic fields frequently stimulate glandular activity in the short term, long term exposure is often harmful in that the gland ceases to work properly. This is particularly serious for the glands of the endocrine system (those that coordinate our bodily functions) since it can affect many aspects of metabolism and throw the whole body out of kilter. For example it may be responsible, at least in part, for the current outbreak of obesity and the many other illnesses that stem from it.

A good example of this is the thyroid gland, which is in an exposed position in the front of the neck. Rajkovic *et al.* (2003) showed that after three months exposure to power line frequencies, the thyroid glands of rats showed visible signs of deterioration. They also lost their ability to produce the thyroid hormones, which they did not recover even after the fields were switched off. Esmekaya *et al.* (2010) found a similar visible deterioration of the thyroid gland in rats exposed to simulated 2G cell phone radiation for 20 minutes a day for three weeks. Eskander *et al.* (2012) found that people living for six years within 100 metres of a cell phone base station showed a significant reduction in the release into the blood of a number of hormones, including ACTH from the pituitary gland, cortisol from the adrenal glands, and prolactin and testosterone from organs elsewhere. However, the most highly significant loss was in their ability to produce the thyroid hormones. The expected consequence of this is hypothyroidism, the most frequent symptoms of which are **fatigue** and **obesity**. It may not be a coincidence that about a quarter of a million UK citizens are now suffering from what is being diagnosed as chronic fatigue syndrome, and about eight out of ten are either overweight or clinically obese.

The incidence of obesity may be exacerbated by effects on the release of the appetite regulating hormones ghrelin and peptide YY. Ghrelin is synthesised in the stomach wall and makes us feel hungry, whereas peptide YY is made in the intestine wall and makes us feel full. In normal people the level of ghrelin in the blood is high before a meal and goes down afterwards whereas peptide YY goes up, so we go from feeling hungry to feeling full, which stops us overeating.

However, in obese people the level of both hormones stays roughly the same throughout so that they never feel completely full and eat in an unregulated manner (Le Roux *et al.* 2005, Le Roux *et al.* 2006). If prolonged exposure to electromagnetic fields limits the release of these hormones in the same way as they affect the release of ACTH, cortisol, prolactin, testosterone and the thyroid hormones, it may explain why so many people find it difficult to stop eating and end up being clinically obese.

If you are affected in this way, you may be forced to go on a life-long diet, undergo gastric bypass surgery to drastically reduce the size of your stomach or risk the many serious diseases that stem from obesity **AND IT MAY NOT HAVE BEEN YOUR FAULT**. Think twice before you use a cell phone or install a cordless phone or WiFi. The consequences are only now becoming apparent; neither the Government nor the telecommunications industry will tell you what they are, but they are not good.

Obesity can trigger many other illnesses

The consequences of obesity include **diabetes, gangrene, high blood pressure, cardiac problems, renal failure and cancer**. Between them, they cause a great deal of human suffering and cost the nation's economy a great deal of money. The annual cost of obesity and related illnesses to the UK economy has been estimated as being around £6.6 – 7.4 billion (McCormick *et al.* 2007).

The annual cost of chronic fatigue syndrome is about \$20000 per affected person in the USA (Reynolds *et al.* <http://www.resource-allocation.com/content/2/1/4>) and about £14000 in the UK (McCrone *et al.* 2003) so a fair estimate of the total annual cost of chronic fatigue syndrome to the UK economy would be somewhere in the region £3.5 billion. The total annual cost of both conditions together is about £10 billion. If part of this is due to microwave telecommunications, measures need to be taken to minimise their effects, and it would be only fair to ask the Industry to pay for this.

Electromagnetic effects on the adrenal gland

Cortisol: - Augner *et al.* (2010) in a double blind study (where neither the subject nor the person recording the results knows whether the radiation is switched on or off) showed that short-term exposure to the radiation from a 2G (GSM) cell phone base station increased the cortisol level in the saliva of human volunteers. Cortisol is a stress hormone that is normally produced in the cortex of the adrenal glands and is controlled by the calcium level in its cells (Davies *et al.* 1985) so electromagnetically- induced membrane leakage letting more calcium into the cytosol should also have this effect.

Cortisol is part of a mechanism that puts the body into a “fight or flight” mode, in which more sugar is released into the blood, sensitivity to pain is reduced and the immune system is suppressed. In fact, cortisol and its relatives are used medicinally to relieve pain and also to suppress the immune system after transplant surgery. However, when exposure to base station radiation does it, it is not good news since the suppression of the immune system will also increase the risk of infection and of developing tumours from precancerous cells that might otherwise have been destroyed.

Adrenalin: - Buchner and Eger (2011) studied the effect of a newly installed 2G cell phone base station on villagers in Bavaria and found that it caused a long-lived increase in the production of adrenalin. This is an important neurotransmitter which acts on adrenergic receptors to increase the calcium concentration in the cytosol. It is also synthesised in the adrenal medulla in response to signals from the sympathetic nervous system. Adrenalin too puts the body into fight or flight mode by diverting resources from the smooth muscles of the gut to the heart muscle and the skeletal muscles needed for flight or combat. In addition, it stimulates the production of cortisol by the adrenal cortex, and indirectly reduces the activity of the immune system, resistance to disease and increases the risk of getting cancer.

Some people get pleasure from the “adrenalin rush” caused by doing energetic or dangerous things, and this could be a contributory factor to the addictive nature of cell phones. However, on the down side, known effects of excess adrenalin include, headaches, cardiac arrhythmia, high blood pressure, tremors, anxiety and inability to sleep. These results confirm and explain some of the findings of Abdel-Rassoul *et al.* (2007) who found that people living near cell towers (masts) had significantly increases in headaches, memory loss, dizziness, tremors and poor sleep.

Effects on the Brain

Calcium leakage and brain function

Normal brain function depends on the orderly transmission of signals through a mass of about 100 billion *neurons*. Neurons are typically highly branched nerve cells. They usually have one long branch (*the axon*), which carries electrical signals as *action potentials* (nerve impulses) to or from other parts of the body or between relatively distant parts of the brain (a nerve contains many axons bundled together). The shorter branches communicate with other neurons where their ends are adjacent at *synapses*. They transmit information across the synapses using a range of *neurotransmitters*, which are chemicals secreted by one neuron and detected by the other.

Calcium ions play an essential role in brain function because a small amount of calcium must enter the cytosol of the neuron before it can release its neurotransmitters (Alberts *et al.* 2002). Electromagnetically-induced membrane leakage would increase the background level of calcium in the neurons so that they release their neurotransmitters sooner. This improves our reaction time to simple stimuli but it can also trigger the spontaneous release of neurotransmitters to send spurious signals that have no right to be there, which makes the brain hyperactive and less able to concentrate.

Autism

Possibly, the greatest damage to the brain from microwaves is when it is first developing in the foetus and the very young child, where it can lead to autism. Dr Dietrich Klinghardt has shown a relationship between microwaves and autism; a summary of his work can be found at <http://electromagnetichealth.org/media-stories/#Autism>.

What is autism?

Autism is a group of life-long disorders (autistic spectrum disorders or ASD) caused by brain malfunctions and is associated with subtle changes in brain anatomy (see Amaral *et al.* 2008 for a review). The core symptoms are an inability to communicate adequately with others and include abnormal social behaviour, poor verbal and non-verbal communication, unusual and restricted interests, and persistent repetitive behaviour. There are also non-core symptoms, such as an increased risk of epileptic seizures, anxiety and mood disorders. ASD has a strong genetic component, occurs predominantly in males and tends to run in families.

Genetic ASD may be caused by calcium entering neurons

It has been hypothesised that some genetic forms of ASD can be accounted for by known mutations in the genes for ion channels that result in an increased background concentration of calcium in neurons. This would be expected to lead to neuronal hyperactivity and the formation of sometimes unnecessary and inappropriate synapses, which in turn can lead to ASD (Krey and Dolmetsch 2007).

Electromagnetic fields also let calcium into neurons

There has been a 60-fold increase in ASD in recent years, which cannot be accounted for by improvements in diagnostic methods and can only be explained by changes in the environment. This increase corresponds in time to the proliferation of mobile telecommunications, WiFi, and microwave ovens as well as extremely low frequency fields from household wiring and domestic appliances. We can now explain at least some of this in terms of electromagnetically-induced membrane leakage leading to brain hyperactivity and abnormal brain development.

How membrane leakage affects neurons

Neurons transmit information between one another in as chemical neurotransmitters that pass across the synapses where they make contact. Their release is normally triggered by a brief pulse of calcium entering their cytosols. If the membrane is leaky due to electromagnetic exposure, it will already have a high internal calcium concentration as calcium leaks in from the much higher concentration outside. This puts the cells into hair-trigger mode so that they are more likely to release neurotransmitters and the brain as a whole may become hyperactive (Beason and Semm 2002; Krey and Dolmetsch 2007, Volkow *et al.* 2011). This results in the brain becoming overloaded with sometimes spurious signals leading to a loss of concentration and attention deficit hyperactive disorder (ADHD).

How does this impact on autism?

Before and just after its birth, a child's brain is a blank canvas, and it goes through an intense period of learning to become aware of the significance of its new sensory inputs, e.g. to recognise its mother's face, her expressions and eventually other people and their relationship to him/her (Hawley and Gunner 2000). During this process, the neurons in the brain make countless new connections, the patterns of which store what the child has learnt. However, after a matter of months, connections that are rarely used are pruned automatically (Huttenlocher and Dabholkar 1997) so that those that remain are hard-wired into the child's psyche. The production of too many spurious signals due to electromagnetic exposure during this period will generate frequent random connections, which will also not be pruned, even though they may not make sense. It may be significant that autistic children tend to have slightly larger heads, possibly to accommodate unpruned neurons (Hill and Frith 2003).

Because the pruning process in electromagnetically-exposed children may be more random, it could leave the child with a defective hard-wired mind-set for social interactions, which may then contribute to the various autistic spectrum disorders. These children are not necessarily unintelligent; they may even have more brain cells than the rest of us and some may actually be savants. They may just be held back from having a normal life by a deficiency in the dedicated hard-wired neural networks needed for efficient communication.

Autism costs the UK economy more than the tax income from cell phones

The incidence of autism has occurred in parallel with the increase in electromagnetic pollution over the last thirty years. The chance of having an autistic child may now be as high as one in fifty. Apart from the personal tragedies for the affected children and their families, autism is of enormous economic importance. In the UK alone, the **annual cost to the Nation in care and lost production exceeds the annual tax revenue from the entire cell phone industry**, which is about 20billion UK pounds.

<http://www2.lse.ac.uk/newsAndMedia/news/archives/2009/05/MartinKnappAutism.aspx> If it

were all due to cell phones, the Government could close down the entire industry and actually show a profit! There may be ways in which the modulation of the signal can be changed to avoid this (see later), but in the meantime, we should do whatever we can to minimise our exposure to information-carrying microwaves, including those from cell phones, DECT phones, WiFi and smart meters. Failure to do this could be very costly.

Electromagnetic intolerance (aka electromagnetic hypersensitivity or EHS)

Electromagnetic intolerance is a condition in which some people experience a wide range of unpleasant symptoms when exposed to weak non-ionising radiation. About 3 percent of the population suffers in this way at present, although only a small proportion of these are as yet so badly affected that they can instantly tell whether a radiating device is switched on or off. At the other end of the scale, there are people who are sensitive but do not yet know it because they are chronically exposed to electromagnetic fields and accept their symptoms as being perfectly normal. Electromagnetic intolerance is in fact a continuum with no clear cut-off point. In some cases there may only be relatively mild symptoms on or after using a cell phone but in severe cases it can prevent people living a normal life and force them to live in almost total isolation. There is every reason to believe that prolonged exposure will increase the severity of the symptoms, so if you suffer from any of them you should do whatever possible to minimise further exposure.

Symptoms of electromagnetic intolerance

Symptoms include skin rashes, cardiac arrhythmia, headaches (sometimes severe), pain in muscles and joints, sensations of heat or cold, pins and needles, tinnitus, dizziness and nausea. A more complete list can be found at <http://www.es-uk.info/info/recognising.asp>. Most if not all of these can be explained by the radiation making cells leak.

When skin cells leak, it is perceived by the body as damage to the tissue. This increases the blood supply to the area to repair the damage and causes the rash.

When the cells of the heart muscle leak it weakens the electrical signals that normally control its contraction. The heart then runs out of control to give cardiac arrhythmia. This is potentially life threatening.

When sensory cells leak, they become hyperactive and send false signals to the brain. We have a variety of sensory cells, but they all work in much the same way. Whenever they sense what they are supposed to sense, they deliberately leak by opening ion channels in their membranes. This reduces the natural voltage across these membranes, which makes them send nerve impulses to the brain. Electromagnetically induced cell leakage would have the same effect, but this time it would make them send *false* signals to the brain to give the false sensations of electromagnetic intolerance. This could also be exacerbated by the nerve cells involved being made hyperactive due to calcium ingress.

When leakage occurs in the sensory cells of the skin, it can give sensations such as heat, cold, tingling, pressure etc, depending on which types of cell are most sensitive in the individual concerned.

When leakage occurs in the sensory hair cells of the cochlea of ear it gives tinnitus, which is a false sensation of sound. When it occurs in the vestibular system (the part of the inner ear that deals with balance and motion) it results in dizziness and symptoms of motion sickness, including nausea.

Hypocalcaemia, electromagnetic intolerance and the parathyroid gland

Symptoms of hypocalcaemia are very similar to those of electromagnetic intolerance and include skin disorders, pins and needles, numbness, sensations of burning, fatigue, muscle cramps, cardiac arrhythmia, gastro-intestinal problems and many others. A more comprehensive list can be found at <http://www.endotext.org/parathyroid/parathyroid7/parathyroid7.htm>. It is possible that some forms of electromagnetic intolerance are due to low levels of calcium in the blood. Electromagnetic exposure would then remove even more calcium from their cell membranes to push them over the edge and give the symptoms of electromagnetic intolerance.

The amount of calcium in the blood is controlled by the parathyroid hormone secreted by the parathyroid gland, which is in the neck, close to where you hold your cell phone. It is adjacent to the thyroid gland and, if it were to be damaged by the radiation in the same way, the production of the parathyroid hormone would go down, the amount of calcium in the blood would be reduced and the person concerned would become electromagnetically intolerant.

Effects on DNA

Cell phone radiation can damage DNA

Lai and Singh (1995) were the first to show this in cultured rat brain cells, but it has since been confirmed by many other workers. A comprehensive study on this was in the Reflex Project, sponsored by the European Commission and replicated in laboratories in several European countries. They found that radiation like that from GSM (2G) cell phone handsets caused both single and double stranded breaks in the DNA of cultured human and animal cells. Not all cell types were equally affected and some, such as lymphocytes, seemed not to be affected at all (Reflex Report 2004).

In susceptible cells, the degree of damage depended on the duration of the exposure. With human fibroblasts, it reached a maximum at around 16 hours (Diem *et al.* 2005). However, it would be unwise to assume that exposures of less than 16 hours are necessarily safe since DNA damage may give genetically aberrant cells long before it becomes obvious under the microscope. It would also be unwise to assume that the damage would be restricted to the immediate vicinity of the handset since, as described earlier, the effects of the radiation can be transmitted in the bloodstream in the form of magnetically conditioned blood; so nowhere is safe, not even the sex organs.

How the DNA is damaged

Because of the very high stability of DNA molecules, they are unlikely to be damaged directly by weak radiation. The most plausible mechanism is that DNase (an enzyme that destroys DNA) and other digestive enzymes leak through the membranes of lysosomes (organelles that digest waste) that have been damaged by the radiation. Other mechanisms involve the leakage of reactive oxygen species (ROS) such as hydrogen peroxide from damaged peroxisomes and superoxide free radicals from damaged mitochondrial membranes and NADH oxidase in the plasma membrane. According to Friedman *et al.* (2007), the first to respond to non-thermal cell phone frequencies is the NADH oxidase in the plasma membrane, which is activated within minutes of exposure.

However, all of these ROS can initiate peroxidation chain reactions in the polyunsaturated phospholipids of cell membranes (the same thing that makes fats go rancid)

which disrupts the membranes further and exacerbates the effect. Only one molecule of ROS is needed to initiate a domino-effect chain reaction, in which each damaged lipid molecule generates a free radical that damages the next one. The process normally stops when it reaches an anti-oxidant molecule, which sacrifices itself by combining with the free radical in such a way that it does not generate a new one. Most of our anti-oxidants come from our diet (e.g. vitamin E) but the most important one that we make ourselves is *melatonin*. It's unfortunate that the production of melatonin by the pineal gland is also disrupted by electromagnetic fields (Henshaw and Reiter, 2005) which makes matters worse.

These ROS are highly reactive and can also damage DNA. In fact, much of the damage done to cells by *ionising radiation* such as *gamma rays* is due to damage to cell membranes and DNA by free radicals from the radiolysis of water. There may therefore be little difference between holding a cell phone to your head and holding a radioactive source of gamma rays. Both can damage cell membranes, cause the fragmentation of DNA and also do considerable collateral damage to other cellular components, which may either kill the cells or make them lose their normal function over time.

Cell phones increase the risk of cancer

If similar DNA fragmentation were to occur in the whole organism, we would expect an increased risk of cancer, since essential genes that control cell division may be either damaged or lost. Recent studies on the incidence of brain cancer are already beginning to show this. Heavy cell phone use roughly doubles the risk of getting brain cancers in adults on the side of the head used for the cell phone. For younger people, the risk increases to five times more (Hardell and Carlberg 2009). Since brain cancers normally take decades to develop, it is too soon to assess the final impact of the radiation, but the World Health Organisation has already classified cell phones as a Group 2B Carcinogen (possibly carcinogenic) similar to benzene and DDT. Other head cancers are also on the increase, including cancers of the parotid salivary gland (next to where you hold your cell phone) and the thyroid gland, which is in the neck.

Cell phones reduce male fertility

We might expect DNA damage in the cells of the germ-line (the line of cells starting in the embryo that eventually gives rise to eggs and sperm) to result in a loss of fertility. A number of epidemiological studies have shown significant reductions in sperm motility, viability and quantity in men using cell phones for more than a few hours a day (Fejes *et al.* 2005; Agarwal *et al.* 2006) and the subject was reviewed by Desai *et al.* (2009). A common finding is that these effects were associated with the production of reactive oxygen species (ROS) which can damage many cellular components, including cell membranes and DNA.

More recently, Agarwal *et al.* (2009) found in controlled experiments that ejaculated sperm from healthy donors showed reduced viability and motility and an increase in ROS after one hour's exposure to a cell phone in talk mode. More recently still, Avandano *et al.* 2012 found that exposing ejaculated semen to a WiFi laptop for four hours gave a decrease in sperm motility and an increase in DNA fragmentation as compared with samples exposed to a similar computer with the WiFi switched off.

A similar relationship between sperm quality and electromagnetic exposure has also been found for low frequency alternating magnetic fields (Li *et al.* 2010). It is therefore advisable for men to avoid strong magnetic fields, restrict their cell phone calls to a minimum and keep them switched off (or in airplane mode if it has this facility). Otherwise, the phones

transmit regularly at full power to the base station, even when not in use. If they have to be switched on for any reason, men should at least keep them out of their trouser pockets.

Possible effects on female fertility

We do not yet know the effects of cell phone use on human female fertility, but . Panagopoulos *et al.* (2007) showed that exposing adult *Drosophila melanogaster* (an insect widely used in genetic experiments) to a GSM phone signal for just six minutes a day for six days fragmented the DNA in the cells that give rise to their eggs and half of these eggs died. We humans should therefore exercise caution since, although our sperm are produced in their countless billions and take about three months to mature, all the eggs that a woman will ever have were in her ovaries before she was born and will be exposed to the radiation (and electromagnetically conditioned blood) throughout her life. There could therefore be considerable cumulative damage, both to the eggs and the follicle cells that nourish and protect them. Damage to either, beginning when the child is in the womb, can be expected to cause a loss of fertility. Pregnant mothers should avoid all present forms of microwave telecommunications, including cell phones and WiFi. Her child could be damaged by their radiation, but she will not know until she reaches puberty and wants a child herself.

Effects on tight junction barriers

Tight junction barriers are layers of cells where the gaps between them are sealed by *tight-junctions* to prevent materials leaking around their sides. They protect all of our body surfaces from the entry of unwanted materials and often protect one part of the body from being unduly influenced by the others. For example, the blood-brain barrier prevents toxins entering the brain from the bloodstream. Normally, these barriers are closed but they are programmed to open if calcium ions enter their cells. This was demonstrated by Kan and Coleman (1988) who showed that the calcium ionophore A23187 (an antibiotic that kills bacteria and fungi by letting calcium ions leak into their cells) opened tight junction barriers in the liver. The electromagnetic opening of the blood-liver barrier could be a contributory factor to the current outbreak of liver disease in the UK among the under forties (the cell phone generation), which is at present being blamed on alcohol abuse. Since all tight junction barriers have basically the same design, unscheduled calcium entry resulting from electromagnetic exposure is likely to open all of them in much the same way. The opening of our tight junction barriers by electromagnetic fields can account for many modern illnesses, ranging from asthma to multiple allergies and Alzheimer's disease.

The blood-brain barrier and early dementia

The blood-brain barrier normally prevents possibly toxic large molecules from the bloodstream entering the brain. The radiation from cell phones, even at one hundredth of the permitted SAR value, can open the blood brain barrier in rats so that protein molecules as large as albumin could enter their brains (Persson *et al.* 1997). Later experiments by Salford *et al.* (2003) showed that this was associated with the death of neurons. We would not expect an immediate effect because the brain has spare capacity, but prolonged or repeated exposure to cell phone or similar radiation would be expected to cause a progressive loss of functional neurons and result in early dementia and Alzheimer's disease in humans. The extreme sensitivity of the blood-brain barrier to the radiation could mean that even sitting close to someone using a cell phone could affect you too. It may not be too surprising to find that early onset Alzheimer's disease is now on the increase in modern society.

The respiratory barrier and asthma

Di *et al.* (2011) showed that exposure to weak ELF electromagnetic fields during pregnancy increased the risk of asthma in the offspring (they did not test microwaves). This

can be explained by the radiation removing structural calcium from the cells of the tight junction barrier lining the respiratory tract, which then opens. This is supported by the findings of Chu *et al.* (2001) who showed that either low levels of external calcium or the addition of EGTA, both of which would remove structural calcium ions from cell surfaces, caused massive increases in its electrical conductance (a measure of its permeability to ions) and also to its permeability to much larger virus particles. We would therefore expect many allergens to enter by the same route and predispose the child to asthma. There are about 5.4 million people with asthma in the UK and the estimated annual cost to the NHS alone is about £1 billion (http://www.asthma.org.uk/news_media/news/new_data_reveals_hig.html)

The skin barrier, allergies and multiple chemical sensitivities

The skin tight junction barrier is in the *stratum granulosum*, which is the outermost layer of *living* skin cells just underneath the many layers of dead cells (Borgens *et al.* 1989). Furuse *et al.* (2002) showed that mutant mice deficient in Claudin-1 (a vital component of the sealing mechanism) died within a day of birth and their skin barriers were permeable to molecules as large as 600D, which is enough to admit many unwanted foreign materials, including potential allergens. In humans, this could be the basis of *multiple chemical sensitivities*, where people have become allergic to a wide range of chemicals, although they leave most of us unaffected. People suffering from multiple chemical sensitivities are often also electromagnetically intolerant and many of their symptoms are very similar.

Virtually all of our body surfaces are protected by cells with tight junctions, including the nasal mucosa (Hussar *et al.* 2002), the lungs (Weiss *et al.* 2003) and the lining of the gut (Arrieta *et al.* 2006). An electromagnetically-induced increase in the permeability of any of these would allow the more rapid entry into the body of a whole range of foreign materials, including allergens, toxins and carcinogens.

Loss of barrier tightness can trigger autoimmune diseases

An electromagnetically-induced increase in the permeability of any of the tight-junction barriers has been linked to the occurrence of autoimmune diseases, in which lymphocytes the immune system attacks the body's own components as if they were foreign materials or pathogens.

The immune system is quite complicated but basically lymphocytes (a type of white blood cell) are trained and selected before they mature to recognise the body's own cells, which are normally present in the bloodstream, by virtue of chemical patterns on their surfaces (the major histocompatibility complexes).

B-lymphocytes make specific antibodies that combine with foreign cells and substances that do not have this pattern, which marks them for eventual ingestion and digestion by phagocytes (another type of white blood cell). T-lymphocytes kill the body's own cells if they are infected with a virus, which is normally displayed on the cell surface. In both cases, the presence of the foreign material or infected cells trigger the rapid multiplication of a clone of lymphocytes that recognise them. They can then attack it in force.

However, if the substance concerned belongs to the body itself but is normally prevented from entering the bloodstream by a tight-junction barrier such as the blood-brain barrier, when that barrier opens, it increases the likelihood of its leaking unfamiliar materials into the bloodstream and triggering an autoimmune response. For example, Grigoriev *et al.* (2010) showed that 30 days exposure to unmodulated 2450MHz microwave radiation triggered a small but significant increase in anti-brain antibodies in the blood of rats. In other

words, the radiation had sensitised the body's immune system to one or more components of its own brain, which could then result in an autoimmune attack on the brain and/or nervous system. An example of an autoimmune disease of the brain is Graves disease in which the pituitary gland (at the base of the brain) is affected.

In addition, an increase in the permeability of the gut barrier has been linked to several other autoimmune diseases, including type-1 diabetes, Crohn's disease, celiac disease, multiple sclerosis and irritable bowel syndrome (Arrieta *et al.* 2006).

Cell membranes as current generators and electrical insulators

Cell membranes not only keep apart materials that must not be allowed to mix, they also act as electrical insulators for the natural electric currents upon which all of our cells depend.

Natural electric currents are important in power and information transfer

Almost every living cell is a seething mass of electric currents and amplifiers. For example, these currents are important in energy production in mitochondria (the cell's power stations) and in cell signalling (the transfer of information within and between cells). They are carried as flows of ions, which are the normal ways in which electricity is carried through water and through living cells.

These natural currents are generated by cell membranes.

Natural electric currents are normally generated by molecular ion pumps in cell membranes. These are proteins that use metabolic energy to transport specific ions, usually one or two at a time, from one side of the membrane to the other. This generates a voltage across the membrane (*the membrane potential*) and a chemical imbalance between the concentrations of ions on either side. Their combined effect gives an *electrochemical gradient*, which provides energy for other functions.

Mitochondria use electrochemical gradients to transmit power

Mitochondria are tiny structures, about the size of bacteria, inside almost all of our cells. They evolved when an aerobic bacterium, which used oxygen to metabolise its food, was engulfed by an anaerobic organism, which could not do his, but was more efficient in other respects. From then on they lived together symbiotically, but are still separate in that the mitochondria are surrounded by two membranes; the inner one belonging to the bacterium and the outer one to its host.

The inner membrane does the electrical work by a process known as chemiosmosis. The inside of the mitochondrion contains enzymes that convert materials from our food into forms that can combine with oxygen. This combination with oxygen occurs using enzymes actually within the membrane, and the released energy is used to expel hydrogen ions to create an electrochemical gradient between the inside and the outside of the mitochondrion. They are then allowed back through another enzyme in the membrane called ATP synthase that uses the gradient to make ATP, which is the main energy currency of the cell. The cycle then repeats to give an electrical circuit with hydrogen ions carrying the electricity from where it is made to where it is used, with the membrane being the insulator (Alberts *et al.* 2002).

What happens if the mitochondrial membrane is damaged?

Damage to the inner mitochondrial membrane can have two main effects. If it just leaked it would short circuit the system, reduce ATP synthesis and deprive the cell of energy. If the damage were also to include the oxidising enzymes, they could release free radicals, which are normal intermediates in the process. This would damage both the inside of the mitochondrion (including its DNA) and also the rest of the cell. Mitochondrial dysfunction of this sort is thought to be a possible cause of chronic fatigue syndrome.

Other membranes also use ion currents to transfer energy

Most other cell membranes use ion currents as a source of energy. For example, enzymes in the outer membrane of each cell (*the plasma membrane*) use energy from ATP to pump positively charged sodium ions out of the cell. This generates its own membrane potential, which typically makes the inside of the cell about 70-100mV negative to the outside. This provides energy for the active transport of other materials across the membrane against a concentration gradient. In this case, the sodium ions that have been expelled are allowed back in, through transporter enzymes, but they carry with them nutrients from the outside by a process called ion co-transport (Alberts *et al.* 2002) If this membrane leaks, it will short circuit the voltage across it and reduce nutrient uptake as well as a number of other processes which use this voltage as a source of energy.

Ion channels in cell membranes are used for cell signalling

Ion channels are pores in cell membranes that can let large quantities of specific ions through very quickly, but only down their own electrochemical gradient. They normally open and close in response to specific stimuli; e.g. changes in voltage across the membrane or the presence of other chemicals. They can be thought of as amplifiers by which a tiny stimulus can cause a very large current to flow almost instantly to give a rapid biological effect. An example of this is the coordinated opening and closing of sodium and potassium channels that continuously amplify nerve impulses and enable them to travel from one end of the body to the other, both rapidly and without loss.

The mechanisms of cell membrane leakage.

We have known since the work of Suzanne Bawin and her co-workers (Bawin *et al.* 1975) that electromagnetic radiation that is far too weak to cause significant heating can nevertheless remove radioactively labelled calcium ions from cell membranes. Later, Carl Blackman showed that this occurs only with weak radiation, and then only within one or more '*amplitude windows*', above and below which there is little or no effect (Blackman *et al.* 1982; Blackman 1990).

The apple harvester: an explanation for amplitude windows

A simple way to explain the selective removal of divalent ions is to imagine trying to harvest ripe apples by shaking the tree. If you don't shake it hard enough, no apples fall off, but if you shake it too hard, they all fall off. However, if you get it just right, only the ripe ones fall off and are 'selectively harvested'.

We can apply the same logic to the positive ions bound to cell membranes. Alternating voltages try to drive these ions off and then back onto the membranes with each cycle. If the voltage is too low, nothing happens. If it is too high, all the ions fly off, but return when the voltage reverses. However, if it is just the right, it will tend to remove only the more

strongly charged ones, such as divalent calcium with its double charge. If the frequency is low, at least some of these divalent ions will diffuse away and be replaced at random by other ions when the field reverses. There will then be a net removal of divalent ions with each successive cycle until enough have been removed to cause significant membrane leakage and give a biological effect, but only within a narrow range of field strength to give an *amplitude window*. Pulses are more effective than smooth sine waves because their rapid rise and fall times catapult the ions quickly away from the membrane and leave more time for them to be replaced by different ions before the field reverses.

Frequency windows and resonance effects

If a molecule or structure has a natural resonant frequency, it may respond selectively to that frequency. For example, if you keep giving a pendulum a gentle push at just the right time at the end of its travel, the energy of each push builds up and is stored in the ever increasing violence of its motion. If you were suddenly to stop it by putting your hand in the way, the combined energy of each push is released in one go and could do more damage to your hand than the energy you gave it from each individual push.

In the same way, if an electrically charged atom or molecule has one or more natural resonant frequencies and you give it an electromagnetic pulse at that frequency, it may store the combined energy of each pulse as some sort of vibration. This could enable it to bring about a chemical reaction that would not have been possible from the energy of each pulse alone, *but only at its resonant frequency*. Some frequencies are especially effective in giving biological effects. An example is 16Hz, which is the ion cyclotron resonance frequency of potassium ions in the Earth's magnetic field.

Ion cyclotron resonance occurs when ions move in a steady magnetic field such as that of the Earth. They are deflected sideways by the magnetic field and go into orbit around its lines of force at a frequency that depends on the charge to mass ratio of the ion and the strength of the steady field (see Liboff *et al.* 1990). If they are simultaneously exposed to an alternating field at this frequency, they absorb its energy and increase the diameter of their orbits, which increases their energy of motion and chemical activity. Potassium resonance is particularly important because potassium is the most abundant positive ion in the cytosols of living cells, where it outnumbers calcium by about ten thousand to one. It is therefore the ion most likely to replace any calcium that has been lost by electromagnetic exposure. An increase in the chemical activity of potassium will therefore increase its ability to replace calcium and so increase calcium loss from the membrane and further reduce its stability.

Calcium loss and leaky membranes underlie many biological effects.

We have seen how the loss of calcium from cell membranes is enhanced at the 16Hz potassium resonant frequency. Also, any metabolic consequences of this calcium loss may be similarly enhanced. Any bioelectromagnetic responses that peak or trough at 16Hz is evidence that they stem from divalent ion depletion in membranes. In fact, many biological responses appear to peak at 16Hz.. These include stimulations of the growth of yeast (Mehedintu and Berg 1997) and higher plants (Smith *et al.* 1993), changes in rate of locomotion in diatoms (McLeod *et al.* 1987), and the especially severe neurophysiological symptoms reported by electrosensitive people exposed to the radiation from TETRA handsets (which is pulsed at 17.6Hz). All of this supports the notion that a large number of the biological responses to weak electromagnetic radiation stem from the loss of calcium (and possibly other divalent ions) from cell membranes.

How calcium removal makes cell membranes leak

Positive ions strengthen cell membranes because they help bind together the negatively charged phospholipid molecules that form a large part of their structure. Calcium ions are particularly good at this because their double positive charge enables them to bind more strongly to the surrounding negative phospholipids by mutual attraction and hold them together like mortar holds together the bricks in a wall. However, monovalent ions are less able to do this (Steck *et al.* 1970, Lew *et al.* 1998, Ha 2001). Therefore, when electromagnetic radiation replaces calcium with monovalent ions, it weakens the membrane and makes it more likely to tear and form temporary pores, especially under the stresses and strains imposed by the moving cell contents. Normally, small pores in phospholipid membranes are self healing (Melikov *et al.* 2001) but, while they remain open, the membrane will have a greater tendency to leak. This can have serious metabolic consequences as unwanted substances diffuse into and out of cells unhindered, and materials in different parts of the cell that should be kept separate, become mixed.

Demodulation

Both extremely low frequencies and radio waves that have been amplitude modulated at extremely low frequencies give biological effects, but unmodulated radio waves are relatively (but not completely) innocuous. This implies that living cells can demodulate a modulated signal to extract the biologically active ELF. Furthermore, if they are to respond to cell phone and WiFi signals, they must be able to do it at microwave frequencies, but how do they do it?

The most likely explanation lies in asymmetric electrical properties of ion channels in cell membranes imposed by the *membrane potential* between the inside and outside of the cell. They will behave like electrically biased point contact Schottky diodes in which electricity passes more easily in one direction than the other. This is all that is needed to rectify and demodulate the signal. A non-biological example of this effect is a radio set that was made from a single carbon nanotube (see <http://tinyurl.com/m4u75o>). The asymmetry induced by applying a DC voltage between its ends allowed it to demodulate and even to amplify radio signals, including those at microwave frequencies.

The nanotube has a similar diameter to a typical ion channel in a cell membrane, so it seems likely that the ion channels in cell membranes could perform a similar function, powered by the cell's membrane potential. The low-frequency component would then appear across the membrane, where it could do most damage. In as much as our *tight junction barriers* have a similar trans-barrier potential (around 70mV for the skin barrier with the inside of body positive) the ion channels of the whole barrier could act in concert to demodulate the signal, the damaging low frequency components of which could then be applied to and affect the whole body.

Natural defence mechanisms

The body is able to detect electromagnetic radiation and so minimise resulting damage. This ability probably evolved over countless millions of years to mitigate the effects of ionising radiation from cosmic rays and non-ionising radio frequencies from lightning during thunderstorms. Some of them are as follows: -

Calcium expulsion

The concentration of free calcium in the cytosols of living cells is normally kept extremely low by metabolically-driven ion pumps in the cell membrane. Under normal circumstances, the entry of free calcium ions is carefully regulated and small changes in

their concentration play a vital role in controlling many aspects of metabolism. These processes can be disrupted if electromagnetically-induced membrane leakage lets extra and unscheduled amounts of calcium into the cell, either from the outside or from calcium stores inside. To compensate for this, the mechanism that normally pumps surplus calcium out can go into overdrive. However, its capacity to do this is limited because, if the pumping were too effective, it would hide the small changes in calcium concentration that normally control metabolism.

Gap junction closure: - If calcium extrusion fails and there is a large rise in internal calcium, it triggers the isolation of the cell concerned by the closure of its gap junctions (tiny strands of cytoplasm that normally connect adjacent cells) (Alberts *et al.* 2002). This also limits the flow of electric currents through the tissue and so reduces the effects of radiation.

Ornithine decarboxylase (ODC)

The activation of the enzyme *ornithine decarboxylase* is triggered by calcium leaking into cells through damaged membranes and by nitric oxide produced by damaged mitochondria. This enzyme leads to the production of chemicals called *polyamines* that help protect DNA and the other nucleic acids needed for protein synthesis. One such polyamine is spermine, which normally protects the DNA of sperm and is also responsible for the characteristic smell of semen.

Heat shock proteins

These were first discovered after exposing cells to heat, but they are also produced in response to a wide variety of other stresses, including weak electromagnetic fields. They are normally produced within minutes of the onset of the stress and combine with the cell's enzymes to protect them from damage and shut down non-essential metabolism (the equivalent of running a computer in "safe mode").

When the production of heat shock proteins is triggered electromagnetically it needs 100 million million times less energy than when triggered by heat, so the effect is truly non-thermal (Blank & Goodman 2000). Their production in response to electromagnetic fields is activated by special base sequences (the nCTCTn motif) in the DNA of their genes. When exposed to electromagnetic fields, they initiate the gene's transcription to form RNA, which is the first stage in the synthesis of the protein (Lin *et al.* 2001). The job of these heat-shock proteins is to combine with vital enzymes, putting them into a sort of cocoon that protects them from damage. However, this stops them working properly and also drains the cell's energy and resources, so it isn't an ideal solution either.

Our defences protect us from thunderstorm radiation but not from cell towers, DECT phones and WiFi

As we can see, our natural defence mechanisms try to limit the electromagnetically-induced damage, but they cannot be deployed without using extra energy and disrupting the cell's normal functions. They originally evolved to protect us from occasional weak natural radiation, such as that from thunderstorms. However, prolonged or repeated exposure such as that from cell towers, WiFi and most DECT base stations is harmful because they normally run continuously and disrupt metabolism for long periods and is expensive in bodily resources.

These resources have to come from somewhere. Some may be drawn from our physical energy, making us feel tired, some may come from our immune systems, making us less resistant to disease and cancer. There is no hidden reserve. As it is, our bodies are constantly juggling resources to put them to best use. For example, during the day, they are

directed towards physical activity but during the night, they are diverted to the repair of accumulated damage and to the immune system. Day and night irradiation from cell phone towers (which run continuously) will affect both, with little or no chance to recover. In the long term, this is likely to cause chronic fatigue, serious immune dysfunction (leading to an increased risk of disease and cancer) and many of the neurological symptoms frequently reported by people living close to mobile phone base stations (see Abdel-Rassoul *et al.* 2007).

How can we make our electromagnetic environment safe?

Firstly, there may be no need to give up our electrical appliances domestic appliances or cell phones. It is possible to make most of them much safer. All that is needed with domestic wiring is low-tech electromagnetic hygiene. As for cell phones, the operators have known for over a decade how to modify the radiated signal to make it safe; they have just chosen not to do so. I will deal with these one at a time.

Domestic wiring

It is easy to screen the electrical field from wiring by enclosing it in earthed metal conduits or using screened cable with an earthed screen. We cannot screen the magnetic field in this way but by careful design of the circuits, we can make the magnetic fields of the live and neutral wires cancel each other out. To do this, all you need is to make sure that the live and neutral wires to any device are as close together as possible (preferably twisted together) with each device having its own connection to the main distribution panel. The cheap UK practice of using ring mains (where many plug sockets are connected in a ring, beginning and ending in the distribution panel) should be made illegal. This is because differences in the resistance of the conductors mean that electricity flowing to any plug socket may not flow back the way it came so that their magnetic fields do not cancel and there will be an unnecessarily high field surrounding the whole ring.

Another source of problems is the use of unearthed double insulated appliances. Although there is very little risk of shock, they still emit strong magnetic fields and electric fields at about half the supply voltage, which some people find intolerable.

Cell phones

While we can block or cancel the electromagnetic fields associated with domestic wiring, we cannot do this with cell phones or DECT phones, which depend on radio frequency radiation transmissions if they are to work. However, we can make this radiation much less biologically active. There are at least two ways to do this. The first was devised tested and patented by Theodore Litovitz working at the Catholic University of America in the 1990s. All you have to do is to add low frequency electromagnetic noise to the signal.

The theory behind Litovitz's method.

His idea was to add a random ELF (noise) magnetic field to the regularly repeating fields from power lines or cell phones. It works on the principle that most of the biological effects of electromagnetic fields are due to the relatively slow but progressive loss of calcium from cell membranes, which then makes them leak. However, the effect on any cell takes place only within certain amplitude windows, as I described earlier. We may not be able to prevent this leakage just by reducing the power of the field. All this might do is to put other cells (perhaps nearer the source) into their amplitude windows and we may be no better off.

However, if we add a second magnetic field with a randomly varying amplitude, cells are constantly being driven in and out of their amplitude windows and do not spend long

enough in their windows to lose significant amounts of calcium before leaving their windows. The lost calcium then floods back and there is no biological effect. This theory has been tested in several biological systems and found to work.

Much of Litovitz's work used the in production of the enzyme ornithine decarboxylase (ODC) by tissue cultures as an indicator of radiation damage to living cells. The activity of this enzyme increases several fold when exposed to electromagnetic fields (Byus et al. 1987). ODC is part of a defence mechanism against the radiation and an increase in its production is taken as an indication that damage is occurring. Conversely, if the random signal prevents its production, it is an indication that damage is not occurring.

Work in Litovitz's laboratory was mainly concerned with mitigating the effects of 60Hz power line frequencies and he found that adding a random (noise) magnetic field of about the same strength completely reversed their effects on ODC production in mouse tissue cultures (Litovitz *et al.* 1994b) and also the deformities induced by 60Hz fields in chick embryos (Litovitz *et al.* 1994a)

They then went on to study the effects of modulation frequency on 845MHz microwave radiation on ODC production in mouse tissue cultures. They found that constant frequencies between 6 and 600Hz were harmful as measured by ODC production. Simple amplitude modulated speech (which is more random) did not stimulate ODC production, neither did frequency modulated microwaves and frequency modulated analogue phone signals. Continuous microwaves had only a slight effect.

Most microwave pulse frequencies are harmful

Penafiel et al. (1997) working in Litovitz's laboratory concluded that there were only serious health problems when the microwaves were modulated to give pulses of a standard height (amplitude) generated at frequencies between 6 and 600Hz. There was virtually no effect above 600Hz. This corresponds to Blackman *et al.* (1988) observation that calcium release from brain tissue did not occur above 510Hz.

It would appear that the mobile telecommunications industry had not done their homework before selecting the pulse frequencies for their digital communications, since they virtually all fall within this biologically active range; e.g. 2G GSM cell phones (217Hz), TETRA (17.6Hz), DECT phones (100Hz), WiFi (10Hz), and 3G UMTS signals with time division duplex (100Hz and 200Hz) all of which are potentially harmful. There could be other harmful effects of the radiation that do not trigger ODC production or calcium release but, at the very least, these pulse frequencies should not have been used if the cell phone industry had acted due diligence. .

However, Litovitz (1997) found that even these could be made safe by superimposing a low frequency magnetic field on the signal. They found that it prevents the production of ornithine decarboxylase (ODC) by mouse tissue cultures in response to digital cell phone signals. For example, a random field between 30 and 100Hz with an RMS strength of 5 microtesla completely inhibited the ODC production induced by a cell phone signal with an SAR of about 2.5 W/kg. A coil within the handset could easily deliver a random magnetic field of this magnitude and probably protect the user from the harmful effects of its radiation.

Also Lai (2004) showed that a 6 microtesla random noise field completely reversed the deleterious effect of 2450 MHz continuous waves with an SAR of 1.2 W/kg on rat memory. In none of the above experiments did the random noise have any effect in its own right and, on these criteria, is completely harmless.

Balanced signal technology

While Litovitz's method might protect the user from the radiation, because magnetic fields dissipate rapidly as you move away from the source, they may not protect other people nearby, who are out of range of the protective random field. By the same token, random low frequency magnetic fields emitted by a cell phone base station would not be able to protect most users. For this you may need something like a system that I devised myself, to which I gave the name "Balanced Signal Technology". I am not claiming any patent rights and anyone who wants to test and use it can do so free of charge.

The principle is very simple and involves transmitting two complementary mirror image signals on different carrier frequencies; i.e. when one has a pulse, the other has a gap. The base station would have no problem with this since they would look like two separate phone calls. However, living cells would be unlikely to distinguish between the two carrier frequencies and the pulses on each would cancel and it would look like a relatively harmless continuous wave. It would need very little extra bandwidth since only one of the signals need be used, with the other one being effectively thrown away and they could all be dumped on the same frequency. In theory, this technology could be applied to both handsets and base stations, but has not yet been tested.

The cell phone companies should know about both methods to make cell phones safer but there is no evidence that they are interested, possibly because to implement them would cost money with no extra benefit to themselves. It looks very much as if they would prefer many people to become sick and perhaps die, rather than admit that their safety rules are based on false premises and that their current technologies are not yet safe.

What can we do about it ourselves?

Very few people would want to give up their cell phones, but if you have one, for your own personal safety, keep your calls on it short and infrequent so that your body has a chance to recover in between times. Use text (which takes seconds to transmit) rather than voice calls and avoid unnecessary Internet downloads. The choice is yours, but spare a thought for the people living near the base stations. Some may be badly affected by their continuous radiation but they have no choice. Your cell phone calls will contribute to their problems, so your restraint may help them too.

Also, don't forget your own personal sources of continuous radiation such as WiFi routers and DECT phone base stations, which can be even more harmful since they are closer. Avoid using WiFi altogether. Ethernet connections via cable are not only safer, but faster, more reliable and offer greater security. Various "Homeplug" devices that connect an the Ethernet socket of your computer to the router via the household electricity supply are second best alternatives. They are not perfect since there is still some radiation from the wiring; especially with those offering faster speeds.

DECT phones should also be avoided if at all possible. But, if you must have one, a reasonable compromise is to use only one that switches off its base station automatically between calls. At the time of writing, the only DECT phones that do this are the Eco Plus models manufactured by Siemens; e.g. the Siemens Gigaset C595. However, make sure they are programmed to work in the Eco Plus mode since this is not the default setting.

Screening and its limitations

Many electromagnetically intolerant people will want to screen themselves from the fields but we need to understand a little about them to get the best results.

The near-field

An alternating electromagnetic field consists of an electrical field and a magnetic field. The electrical field is produced by a voltage gradient and is measured in volts per metre. The magnetic field is generated by a flow of current and is measured in tesla. When you are close to the source (typically within one wavelength) you are in the *near-field*, where the electrical and magnetic fields are mainly separate.

At power line frequencies, the wavelengths run into thousands of miles, so you are bound to be in the near field for power lines. For example, standing under an alternating power line would expose you to a voltage gradient due to the difference between the voltage of the line (set by the power company) and the Earth. You would also be exposed to a *magnetic* field proportional to the current actually flowing through the line, which depends on consumer demand. Both the magnetic and the electrical fields can induce electric currents in your body and are potentially harmful, but the magnetic field is worse because it penetrates living tissues more easily, goes through most walls and aluminium foil as if they were not there, and is very difficult to screen.

The far field

However, as you move away from the source, the two fields feed on each other's energy and combine to give photons of radio waves. This is usually complete within a few wavelengths, after which you are in the so called *far-field* where all the power takes the form of radio waves. Your exposure to these is usually measured in units of power (e.g. microwatts per square metre) or its associated voltage gradient (e.g. volts per metre).

The importance of this as far as we are concerned is that radio waves, are like light waves and are relatively easy to absorb and reflect. This can be done, using earthed metal foil or other electrically conductive materials such as carbon-based paints and metallised textiles. For practical purposes, this means that you can screen yourself against the radiation from a cell tower, WiFi router, or DECT phone base station if they are several wavelengths away (several tens of centimetres) but not from a cell phone held against your head, where you are in the near field and the raw magnetic component will penetrate deep into your brain.

To give an idea of the hazard, magnetic fields lower than one microtesla (a millionth of a tesla) can produce biological effects, but using a 2G (GSM) cell phone or a PDA exposes you to low frequency magnetic pulses that peak at several tens of microtesla (Jokela *et al.* 2004; Sage *et al.* 2007). These come mainly from the battery circuits and are well over the minimum needed to give harmful effects. When they are added to the damaging effects of their microwave fields themselves, these devices are potentially the most dangerous sources of electromagnetic fields and radiation that the average person possesses.

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Dr. Richard Meltzer Comments, Radio Frequency (RF) Exposure:
A Cautionary Tale; Sep. 3, 2013

FCC 12-152

**Before the
Federal Communications Commission
Washington, D.C. 20554**

In the Matter of)	
)	
Notice of Proposed Rulemaking)	
18 FCC Rcd 13187, 13188 ¶1 (2003))	ET Docket No. 03-137
)	
And)	
)	
Service Rules for the Advanced Wireless Services)	WT Docket No. 12-357
H Block---Implementing Section 6401 of the)	
Middle Class Tax Relief and Job Creation Act of)	
2012 Related to the 1915-1920 MHz and)	
1995-2000 MHz Bands ¶53 footnote 95)	

To: Office of the Secretary
Federal Communications Commission
Washington, DC 20554

Reply Filed by: Michael Schwaebe
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February 23, 2013

AFFIDAVIT OF Michael Schwaebe

State of California

San Diego County

I, Michael Schwaebe, attest that my statements are true to the best of my knowledge.

Reply Comment round for ET Docket No. 03-137 and WT Docket No. 12-357.

1. My name is Michael Schwaebe. My address is 215 Andrew Ave, Encinitas, CA 92024.
2. I am a professional engineer and a Building Biology Environmental Consultant.
3. and onward. Radiofrequency radiation has been known to cause biological effects for more than 40 years. In 1972, Zorach R. Glaser, Ph.D., LT, MSC, USNR of the Naval Medical Research Institute, published a paper called *Bibliography of Reported Biological Phenomenon ('Effects') and Clinical Manifestations Attributed to Microwave and Radio-frequency Radiation* (<http://www.dtic.mil/dtic/tr/fulltext/u2/750271.pdf>), where he categorized the different biological effects from RFR based on more than 1,000 research citations.

A modern day version of this document is the *BioInitiative Report*, found at BioInitiative.org. Biological effects in 8 categories (stress proteins, HSP, disrupted immune function; brain tumors and blood-brain barrier; reproductive/fertility effects; sleep, neuron firing rate, EEG, memory, learning, behavior; oxidative damage/ROS/DNA repair failure; cancer, other than brain, cell proliferation; disrupted calcium metabolism; and cardiac, heart muscles, blood pressure, vascular effects) are listed as a function of RFR power density here: <http://www.bioinitiative.org/report/wp-content/uploads/pdfs/BioInitiativeReport-RF-Color-Charts.pdf>.

When looking at biological effects it is peak power that is most damaging and so it is crucial in setting protective limits that this be addressed. Otherwise, the peak power is deluded using averaging criteria.

Respectfully submitted by

Michael Schwaebe
215 Andrew Ave
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February 23, 2013

Dr. Donald R. Maisch PhD. Comments, Feb. 6, 2013

FCC 12-152

**Before the
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In the Matter of)	
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To: Office of the Secretary
Federal Communications Commission
Washington, DC 20554

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February 6 , 2013

AFFIDAVIT OF Donald R Maisch

State of Tasmania, Australia]

I, Donald R. Maisch, attest that my statements are true to the best of my knowledge.

Comment round for ET Docket No. 03-137 and WT Docket No. 12-357.

1. My name is Donald R. Maisch and my address is 143 Gordons Hill Road, Lindisfarne, Tasmania, Australia, 7015. I am a citizen of both Australia and the United States.

2. I am an environmental consultant advising on both power frequency and telecommunications frequency issues and science writer for the Australasian College of Nutritional & Environmental Medicine. I have been directly involved in telecommunications standard setting since 1996. From 1998 to 2001, I was a member of the Standards Australia TE/7 Committee: Human Exposure to Electromagnetic Fields. (Radiofrequency standards) which concluded in 2001. From 2004 to 2009 I was enrolled in a PhD research program at the University of Wollongong, New South Wales, Australia. My area of research was examining the health risk assessment process as it applies to the development of Western telecommunications standard setting. In 2010 my thesis, *The Procrustean Approach: setting Exposure Standards for Telecommunications Frequency Electromagnetic Radiation*, passed external review and was accepted by the university. I have included that document as an essential part of my submission to the FCC.

3. I have focused my PhD research on the controversy over the level of health protection that is provided by the internationally recognized radiofrequency exposure standards / guidelines. These are the RF standard developed under the auspices of the Institute of Electrical and Electronic Engineers (IEEE C95.1) and the RF guidelines promoted by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). In my examination of the established literature base used to set thermally based RF standards such as IEEE C95.1, and ICNIRP's RF guidelines, it is seen that consideration of other possible biological effects not related to heating have not been taken into account in the setting of the exposure limits in these standards / guidelines. It is my opinion that there is now sufficient scientific data in the peer reviewed and published RF literature base to justify a re-examination of possible non-thermal biological effects from human exposure to radiofrequency and microwave (RF/MW) exposure with the aim of including these effects in setting human exposure limits.

4. This idea is not new, and was a concern of the U.S. Radiofrequency Interagency Work Group (RFIAWG) a governmental interagency committee

working under the House of Representatives' Committee on Commerce. Working group membership included the Food and Drug Administration (FDA), the Center for Device and Radiological Health (CDRH), the National Institute for Occupational Safety and Health (NIOSH), the Environmental Protection Agency (EPA), the Occupational Safety and Health Administration (OSHA), the National Telecommunications and Information Administration (NTIA) and the Federal Communications Commission (FCC)¹ (Appendix B). With this work group membership, a significant difference of opinion was expressed over the adequacy of the thermally based proposed IEEE C95.1 standard revisions, compared to that of the industry make up of the IEEE standard setting committee, SCC-28 subcommittee IV. These differing expert opinions illustrated that differing scientific interpretations of the same scientific literature base was very much according to one's affiliations.

In June 1999 Gregory Lotz, representing NIOSH on the RFIAGWG, presented the Chairman of the SCC-28 subcommittee IV a list of issues that RFIAGWG considered needed to be addressed in the IEEE RF standard. The list was in response to previous requests from the work group for greater participation in SCC-28 discussions on RF standards.² In particular, RFIAGWG criticised the biological rationale of the standard on a number of fronts. A fundamental issue was the standard's failure to address chronic (low intensity/prolonged) as opposed to acute (high intensity/short term) exposures. This was seen in the standard's limiting the definition of an "adverse effect level" to only acute exposure situations and the use of time-averaged calculations that were not suitable for prolonged exposure situations and therefore may not adequately protect the public. RFIAGWG recommended that a clear rationale needed to be developed to also include chronic exposures.³ Another concern was the standard's incorrect assumption that all tissues are equally sensitive (other than the eyes and testicles) to RF. This failed to take into consideration the differing sensitivity of human tissue when calculating SAR limits.⁴ There was also a concern expressed about failure to include consideration of the body of research on the biological effects of exposure to ELF-modulated and pulse modulated RF that was relevant to public exposures. In addition, the SAR time- averaging calculations as used in the standard hid any biological effects resulting from modulated RF exposures.⁵ RFIAGWG also questioned the biological validity of the IEEE's two-tier exposure classification, "controlled" vs. "uncontrolled". Besides not being adequately explained, a rationale needed to be given as to why people in uncontrolled environments needed to be protected to a greater extent than persons in controlled environments, when such situations historically were based on biological considerations.⁶ Another issue for RFIAGWG was the rationale

¹ E. Jacobson, Deputy Director, Center for Devices and Radiological Health, FDA Letter Regarding Cellular Phones, May 5, 1997

² G. Lotz, RFIAGWG, RF Guideline Issues: Identified by members of the Federal RF Interagency Work Group, June 1999, letter from Gregory Lotz to Richard Tell, Chair of IEEE SCC28 IV

³ Lotz, op. cit., p. 1-2.

⁴ ibid.

⁵ Lotz, op. cit., p. 5

⁶ Lotz, op. cit., pp. 3-4

for the relaxation of the exposure limits above 1.5 Ghz that “caused concern that the standard is not restrictive enough for continuous exposures at lower microwave frequencies where new wireless applications for consumers could make this an issue in the future”.⁷ To address these concerns the working group recommended a comprehensive review of long-term, low-level exposure studies that had relevance to environmental chronic occupational RF exposures and neurological-behavioural effects to better define the adverse effect level for RF, and micronucleus assay studies with relevance to carcinogenesis.⁸

5. Despite the concerns raised by the RFIAWG these were simply ignored in subsequent IEEE C95.1 standard revisions, as seen in relation to the IEEE’s 12 guiding principles for RF standard setting. These 12 “Guiding principles” for setting RF exposure standards were published in 2003 by the IEEE’s International Committee on Electromagnetic Safety’s (ICES) Subcommittee 4 (SC4). These ‘principles’ were referred to as “a valuable reference on the subject for many years to come”⁹ They state in part that standard exposure limits should be based on established adverse effects, that the thermal effect is the only established adverse effect and that non-thermal effects are not established. These so-called principles could only be set by ignoring the very valid concerns of the RFIAWG. Setting such a firm principle on scientific inquiry for years to come, based on a very selective assessment of the science, is ill advised as it can limit the scope of future scientific research to what is already “established”. I would urge the FCC not to go down this path.

6. Two alternative reviews of the RF literature base, the “Bioinitiative Report”¹⁰ and the ICEMS review, “Non-Thermal Effects and Mechanisms of Interaction Between Electromagnetic Fields and Living Matter”¹¹ are in general agreement with the RFIAWG concerns over limiting public health protection in RF standard setting to thermal considerations only. What the RFIAWG concerns, and these two reviews indicate, is that there is substantial peer reviewed and published research in existence that found scientific evidence of adverse biological effects at exposure levels far below the official standard limits/ guidelines that are based on thermoregulatory considerations.

7. It is my opinion that this extensive data base should no longer be ignored in setting human exposure standards which should be based on biologically relevant end points and not just thermal considerations.

⁷ Lotz, op. cit., p. 6

⁸ Lotz, op. cit., p.7

⁹ C-K. Chou, J. D’Andrea, ‘Reviews of the Effects of RF Fields on Various Aspects of Human Health: Introduction’, *Bioelectromagnetics, Supplement 6*, 2003, pp. S5-S6.

¹⁰ Blackman, C. et al., “BioInitiative Report: A Rationale for a Biologically-based Public Exposure Standard for Electromagnetic Fields (ELF and RF)”, Updated Jan. 2013

¹¹ Giuliani, L. and M. Soffritti (eds), “Non-Thermal Effects and Mechanisms of Interaction Between Electromagnetic Fields and Living Matter”, ICEMS Monograph for the European Journal of Oncology, vol. 5, 2010

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Biological Effects from RF Radiation at Low-Intensity Exposure, based on the BioInitiative 2012 Report, and the Implications for Smart Meters and Smart Appliances; Dr. Ron M. Powell PhD.; 2013

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Biological Effects from RF Radiation at Low-Intensity Exposure, based on the BioInitiative 2012 Report, and the Implications for Smart Meters and Smart Appliances

Introduction and Conclusions

The Biological Effects Chart, at the end of this document, has been produced using data from a massive new review of the medical research literature on the biological effects of electromagnetic fields. That review is called the BioInitiative 2012 Report.² The purpose of the Biological Effects Chart is to show the radiofrequency (RF) exposure levels at which biological effects were found in 67 studies from the RF Color Charts of the BioInitiative 2012 Report, and then to compare those exposure levels to the following:

- (1) current FCC Maximum Permitted Exposure (MPE) limits that govern Smart Meters and Smart Appliances in the United States
- (2) new biologically based RF exposure limits proposed in the BioInitiative 2012 Report
- (3) calculated RF exposure levels produced by a single Smart Meter at various distances
- (4) calculated RF exposure levels produced by a single Smart Appliance at various distances

This comparison is based on RF exposure levels expressed as the RF power density (RF power per unit area). This comparison does not address other potentially important factors such as carrier continuity (continuous versus pulsed radiation) and modulation technique (the method used to impress information on the carrier), among others. The purpose is to identify what biological effects arise from exposure to RF power density levels like those produced by Smart Meters and Smart Appliances.

This comparison indicates the following:

- (1) The current FCC Maximum Permitted Exposure (MPE) limits are so high that they provide no protection for the public from the biological effects found in any of the 67 studies.
- (2) New biologically based RF exposure limits proposed in the BioInitiative 2012 Report are 1 million times lower than current FCC limits and would protect against the biological effects found in nearly all of the 67 studies.
- (3) A single Smart Meter on a home can produce RF exposure levels that caused the biological effects found in either most or many of the 67 studies, depending on the distance from the Smart Meter.
- (4) A single Smart Appliance in the home can produce RF exposure levels that caused the biological effects found in nearly half or fewer of the 67 studies, depending on the distance from the Smart Appliance. Multiple Smart Appliances in a home multiply the total exposure.

¹ The author holds a Ph.D. in Applied Physics from Harvard University, 1975.

² BioInitiative Working Group, Cindy Sage and David O. Carpenter, Editors, BioInitiative Report: A Rationale for Biologically-based Public Exposure Standards for Electromagnetic Radiation, December 31, 2012 (<http://www.bioinitiative.org>).

(5) A single Smart Meter on a nearest neighbor's home can produce RF exposure levels that caused the biological effects found in many of the 67 studies. A given home may have one to eight nearest neighbors, each with a Smart Meter, multiplying the total exposure in the given home.

Other observations:

(1) Most biological effects of RF exposure cannot be sensed by human beings. Examples are the onset of cancer, DNA damage, and fertility effects. One category of effects that can often be sensed includes neurological effects on sleep, memory, learning, and behavior.

(2) Unborn and very young children may be more affected by RF exposure than adults.

This document provides background information, an explanation of each feature of the Biological Effects Chart, and a detailed discussion of each of the conclusions and observations summarized above. That discussion begins on page 11.

Figure 1, on page 9 in this document, and the Biological Effects Chart, at the end of this document, are in color, and are most easily understood when viewed in color. But they can also be understood in black and white. To make that possible, key lines in Figure 1 and in the Biological Effects Chart are identified not only by color but also by line thickness and line style (solid versus dashed).

Terminology for Parts of the Electromagnetic Spectrum

Electromagnetic fields occur over a wide range of frequencies, referred to as the electromagnetic spectrum.³ But the terms used for parts of that spectrum are not consistently named or defined. The BioInitiative 2012 Report uses the following definitions for two key parts of the electromagnetic spectrum:

extra low frequency (ELF): electromagnetic fields with frequencies from 1 to 300 Hz⁴
radiofrequency (RF): electromagnetic fields with frequencies from 100 kHz to 300 GHz⁵

Within the *radiofrequencies* lie the *microwave* frequencies. Microwaves, too, are variously defined. Here are two common definitions:

microwaves: electromagnetic fields with frequencies from 300 MHz to 300 GHz⁶
microwaves: electromagnetic fields with frequencies from 1 GHz to 100 GHz⁷

This document focuses on the biological effects of the frequencies at which the following devices operate. Those frequencies are shown in round numbers.

³ Explanation of units of measure for frequency: 1 hertz is 1 cycle per second. 1 kilohertz is equivalent to 1000 hertz. 1 megahertz is equivalent to 1000 kilohertz and to 1,000,000 hertz. 1 gigahertz is equivalent to 1000 megahertz and to 1,000,000 kilohertz and to 1,000,000,000 hertz. These units are abbreviated as follows: hertz (Hz), kilohertz (kHz), megahertz (MHz), and gigahertz (GHz).

⁴ BioInitiative 2012 Report cited in footnote 2 on page 1, Section 26, Glossary of Terms and Abbreviations, page 3. The Report notes that the term Extremely Low Frequency is used in Europe and the term Extra Low Frequency is used in the United States. Wikipedia uses the term Extremely Low Frequency to refer to 3 to 300 hertz (http://en.wikipedia.org/wiki/Extremely_low_frequency).

⁵ BioInitiative 2012 Report cited in footnote 2 on page 1, Section 26, Glossary of Terms and Abbreviations, page 5.

⁶ (<http://en.wikipedia.org/wiki/Microwaves>)

⁷ (<http://en.wikipedia.org/wiki/Microwaves>)

cell towers ⁸	300, 400, 700, 800, 900, 950, 1800, 1900, 2100 MHz
Wi-Fi (most common type of WLAN) ⁹	2400, 2500 MHz (predominant) 2600, 3600, 5000 MHz (emerging)
wireless laptops ¹⁰	2400 MHz (predominant) 5000 MHz (emerging)
Smart Meters ¹¹	900, 2400 MHz (Smart Meters and Collector Smart Meters) 850 MHz (Collector Smart Meters only)
Smart Appliances ¹²	2400 MHz

Note that that all of these devices operate at frequencies between 300 MHz and 5000 MHz. The frequencies at which Smart Meters and Smart Appliances operate are right in the middle of this range. According to one or more of the definitions given above, all of these frequencies may be referred to as either *radiofrequencies (RF)* or *microwaves*. Since the BioInitiative 2012 Report refers to these frequencies as *radiofrequencies (RF)*, that term will be used here. But the term *microwaves* could have been used just as well.

The BioInitiative 2012 Report

The BioInitiative 2012 Report was developed by an international group of 29 individuals with expertise on the biological effects of electromagnetic fields, or on the related public-health issues.¹³ As a group, these experts hold 20 PhD degrees, one DrSc degree, 9 MD degrees, one DVM degree, and four degrees of MSc, MA, MPH, or MSPAS. These experts come from ten countries, each with the following number of participants:

USA	10	India	2
Sweden	6	Italy	2
Austria	2	Denmark	1
Canada	2	Russia	1
Greece	2	Slovak Republic	1

The goal of the BioInitiative Report is to present “a solid scientific and public health policy assessment that is evidence-based.” The report was prepared “independent of governments, existing bodies and industry professional societies that have clung to old standards.”¹⁴

⁸ (http://en.wikipedia.org/wiki/Cellular_network), (http://en.wikipedia.org/wiki/GSM_frequency_bands), and (http://en.wikipedia.org/wiki/UMTS_frequency_bands)

⁹ (<http://en.wikipedia.org/wiki/Wi-Fi>) and (http://en.wikipedia.org/wiki/List_of_WLAN_channels)

¹⁰ (http://en.wikipedia.org/wiki/Wireless_LAN)

¹¹ Both the Landis-Gyr FOCUS AXR-SD and the General Electric I-210+c Smart Meters, being installed in Maryland, have FCC ID OWS-NIC514. They send and receive information in two microwave frequency ranges: (1) 902.3 to 926.9 MHz, and (2) 2405.8 to 2480.9 MHz (<http://stopsmartmeters.org/wp-content/uploads/2012/01/OWS-NIC514-FCC-specifications.pdf>). Collector Smart Meters have a third transmission frequency of 850 MHz (http://sagereports.com/smart-meter-rf/?page_id=210). They receive and retransmit the signals from Smart Meters to assure that those signals reach the antennas of the electric power company. It is not clear to me at this time whether Collector Smart Meters are employed in all installations of Smart Meters.

¹² The most likely transmitter/receiver in the Smart Appliances is the so-called ZigBee device. ZigBee devices operate at 865 MHz (in Europe) and 915 MHz (in the USA and Australia) as well as 2.4 GHz (worldwide) (<https://en.wikipedia.org/wiki/ZigBee>). But the Smart Meters first observed in installations in Maryland seem to require that the ZigBee devices operate at 2.4 GHz.

¹³ BioInitiative 2012 Report cited in footnote 2 on page 1, cover page of the full report, as a single PDF file.

¹⁴ BioInitiative 2012 Report cited in footnote 2 on page 1, Section i, Preface 2012, page 2.

The Scope of the BioInitiative 2012 Report

The 1479-page BioInitiative 2012 Report considers the “content and implications of about 1800 new studies” since the last BioInitiative Report was published in 2007.¹⁵ The 2012 Report contains 16 chapters that address key categories of biological effects. The 2012 Report also contains several chapters that address key public policy issues, such as the nature and shortcomings of the current exposure standards, and the bases for sufficient argument for changing those standards. Emphasized is the importance of weighing the magnitude of potential harm against the evidence of potential harm, to determine when protective action should be triggered.¹⁶ Since Smart Meters are being mandated for entire populations in the United States, the magnitude of potential harm is considerable, so prudence dictates serious consideration of the increasing evidence of harm.

The Data Source for the Biological Effects Chart

The data for the appended Biological Effects Chart were drawn from the so-called RF Color Charts in the BioInitiative 2012 Report.¹⁷ The RF Color Charts contain two charts:

The first chart describes 67 studies of the biological effects of radiofrequency (RF) radiation.¹⁸ Each study represents one or more biological effects found at a one value of the RF power density (RF power per unit area) or within a range of such values. These data are especially useful when considering whole-body exposure, which is the type of exposure that human beings receive from Smart Meters at a distance of 1 meter or more.¹⁹ These data form the basis for the appended Biological Effects Chart.

The second chart describes 68 studies of the biological effects of radiofrequency (RF) radiation.²⁰ In this chart, each study represents one or more biological effects found at one Specific Absorption Rate, or SAR value, or within a range of such values. A SAR value is the RF power absorbed per unit mass of the biological entity being irradiated. These data are especially useful when less than the entire body is irradiated, and at very close distances, such as when a cell phone irradiates the head.

¹⁵ BioInitiative 2012 Report cited in footnote 2 on page 1, Section 1, Summary for the Public and Conclusions, 2012 Supplement: Summary for the Public – Ms. Sage, page 3.

¹⁶ BioInitiative 2012 Report, cited in footnote 2 on page 1, Table 1-1, Section 23: The Precautionary Principle, 2012 Supplement: The Precautionary Principle – Mr. Gee, page 2.

¹⁷ BioInitiative 2012 Report, cited in footnote 2 on page 1, Section 1, Summary for the Public and Conclusions, Table 1-2 Reported Biological Effects from Radiofrequency Radiation at Low-Intensity Exposure 2012, no page numbers.

¹⁸ Each study in the first chart derives from one publication. But three publications contributed two studies, and one publication contributed three studies. As a result, the 67 studies derive from 62 publications. So the terms *studies* and *publications* have slightly different meanings as used here.

¹⁹ More specifically, the power density values used in the first table are valid in the “far field” (also called the “radiative field”) of the Smart Meter. For the type of antenna in a Smart Meter or a Collector Smart Meter, the far field should begin about two wavelengths from the meter (http://en.wikipedia.org/wiki/Far_field). A Collector Smart Meter transmits on three frequencies (850, 900, and 2400 MHz). The longest wavelength transmitted by a Collector Smart Meter is determined by the lowest frequency which it transmits, which is 850 MHz. That wavelength is 0.35 meters (about 1 foot). A Smart Meter transmits on two frequencies (900 MHz and 2400 MHz), so the lowest frequency transmitted by a Smart Meter is 900 MHz, and the longest wavelength it transmits is 0.33 meters (again about 1 foot). Smart Appliances are expected to transmit at 2400 GHz, with has a wavelength of 0.13 meters (about 5 inches). So for all three devices, the far field begins about 0.7 meters (about 2 feet), or less, from them. This document addresses distances from 1 meter (about 3 feet) up, so all such distances are in the far field for all three devices.

²⁰ Each study in the second chart derives from one publication. But two publications contributed two studies each. As a result the 68 studies derive from 66 publications. So the terms *studies* and *publications* have slightly different meanings as used here.

This is not the usual case for RF exposure from Smart Meters, so these data were not used for the appended Biological Effects Chart.

Criteria for Selection of the Studies in the RF Color Charts

The criteria used in the BioInitiative 2012 Report to select the studies for the RF Color Charts, and thus for the appended Biological Effects Chart, were the following:²¹

- (1) A selection of good examples only. Not intended to be comprehensive.
- (2) Peer-reviewed and published studies only.
- (3) Good exposure data (numeric).
- (4) Author(s) have clear methods and conclusions.
- (5) Cover wide range of topics, such as genotoxicity, neurological, immune, cancers, behavior, attention, memory, sleep, etc.
- (6) Cover wide range of exposure levels, with an emphasis on the lowest levels and the more recent studies.

Every study in the first chart of the RF Color Charts, and thus every study in the appended Biological Effects Chart based on that first chart, except one (Dumansky, 1974), was published after 1986. 1986 is the year of publication of the document on which the current FCC Maximum Permitted Exposure (MPE) limits are principally based.²² That was 27 years ago, which is one factor in explaining why the current FCC MPE limits are out of date. The references for the studies in the RF Color Charts, and thus for the biological effects data in the appended Biological Effects Chart, are included in the reference list that immediately follows the RF Color Charts in the PDF file of the full BioInitiative 2012 Report.²³

Explanation of the Appended Biological Effects Chart

The Horizontal Axis of the Biological Effects Chart

The studies are presented in order of increasing RF power density along the horizontal axis of the Biological Effects Chart. That order facilitates comparing effects observed at similar RF power densities. Each position along the horizontal axis of the Biological Effects Chart represents one study whose principal author and date of publication are written under that axis. The studies could just as well have been ordered alphabetically by the authors' last names, or numerically by the publication dates.

The Vertical Axis of the Biological Effects Chart

The vertical axis represents the RF power densities at which each study was conducted. These power densities cover a wide range of values, so a logarithmic vertical axis was employed. This approach permitted displaying 11 orders of magnitude on the Biological Effects Chart.²⁴ The units of measure

²¹ The criteria were provided by Cindy Sage, co-editor of BioInitiative 2012, in a private communication, April 23, 2013.

²² The current FCC exposure limits are based principally on a 1986 publication of the National Council on Radiation Protection and Measurements (NCRP). That publication is "Report No. 086 - Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields". The NCRP was chartered by the U.S. Congress in 1964, but is not a Government agency and is not subject to oversight by the Congress.

²³ BioInitiative 2012 Report cited in footnote 2 on page 1, Reported Biological Effects from Radiofrequency Radiation (RFR) at Low-Intensity Exposure Levels, sequential pages 112-121 in the 1479-page PDF version of the full Report.

²⁴ Each order of magnitude is a factor of 10.

selected for the vertical axis are milliwatts per square meter (mW/m^2).²⁵ These units work well for the wide range of power densities required for the vertical axis, making the length of the smallest number, 0.000001, not too much longer than the length of the largest number, 10000.

The selected units for the vertical axis also work well for relating the RF power density shown to the total RF power that an adult human would receive. The surface area of an adult human is about 2 square meters (m^2).²⁶ So the surface area that an adult human presents to an RF wave arriving from the front, or from the back, is about 1 square meter (m^2). So when an adult human faces an oncoming wave of radiation with a power density of, say, 10 milliwatts per square meter (mW/m^2), that human will receive a total of 10 milliwatts (mW) of radiation over the entire body. That is, the number describing the power density will be the same as the number describing the total power received, even though the units of measure are different in the two cases. So, when examining the vertical axis of the attached Biological Effects Chart, each number on that axis may be taken to mean *both* the power density (in mW/m^2) of the oncoming wave of RF radiation *and* the total RF power (in mW) received by an adult human when standing with the front, or the back, facing the direction from which the radiation is coming.

The Round Red Dots on the Biological Effects Chart

Each round **red** dot • on the attached Biological Effects Chart indicates the RF power density at which the study named on the horizontal axis, directly below the dot, was conducted. Some studies were conducted over a range of power densities. In such cases, the average value of the high and low ends of the range determines the location of the dot on the vertical axis. The range of power densities applicable is shown as a black vertical line through the dot. The top of the vertical line marks the high end of the range, and the bottom of the vertical line marks the low end of the range. On those vertical lines, the dots appear higher than the middle. That effect results from the logarithmic vertical axis, even though the dots are located at the true average value of the high and low ends of the range.

The Alphabetic Codes above the Dots on the Biological Effects Chart

A one- or two-letter code appears just above each of the dots on the Biological Effects Chart. Each code, such as “CB”, identifies the category into which the biological effects found by a given study fall. Those one- and two-letter codes are translated in the table on the Biological Effects Chart, first into the one or two words represented by the letters of the codes, and then into a fuller description of the category, as reported in the RF Color Charts of the BioInitiative 2012 Report. For example, the code “CB” stands for the words “Cancer, Brain” and represents a category that contains “Brain tumors and blood-brain barrier”.²⁷ Similarly, the code “CO” stands for the words “Cancer, Other” and represents a category that contains “Cancer (other than brain), cell proliferation”.

The Thick Horizontal Blue Line at the Top of the Biological Effects Chart

The thick horizontal **blue** line, which appears at the top of the Biological Effects Chart, represents the Maximum Permitted Exposure (MPE) limits of the Federal Communications Commission (FCC). These are the limits applicable to the general population for uncontrolled exposure for the frequencies that Smart

²⁵ 1 milliwatt (mW) is one-thousandth of a watt (W).

²⁶ The surface area of a man is about 1.9 square meters (m^2); and the surface area of a woman is about 1.6 square meters (m^2), both according to Wikipedia (http://en.wikipedia.org/wiki/Body_surface_area).

²⁷ The reference to blood-brain barrier refers to the weakening of the barrier that the body erects between the blood and the brain to prevent harmful entities circulating in the blood from entering the brain.

Meters, Collector Smart Meters, and Smart Appliances use: 2400 MHz, 900 MHz, and 850 MHz. The top edge of the blue line is the limit applicable to 2400 MHz. The bottom edge of the blue line is the limit applicable to 850 MHz. The limit applicable to 900 MHz falls in between.

Frequency (MHz)	FCC Maximum Permitted Exposure (MPE) Limits ²⁸ (mW/m ²)	
2400	10,000	(Smart Meters, Collector Smart Meters, and Smart Appliances)
900	6000	(Smart Meters and Collector Smart Meters)
850	5700	(Collector Smart Meters)

However, those FCC limits apply to the time-average RF power density over a period of 30 minutes. So, pulsed signals, like those issued by Smart Meters and Smart Appliances, are permitted to assume even higher peak values, as long as the time-average over a period of 30 minutes is below the FCC limits shown.

The Thick Horizontal Yellow Line on the Biological Effects Chart

The thick horizontal yellow line, which appears about one-third from the bottom of the Biological Effects Chart, shows the new RF exposure limits proposed in the BioInitiative 2012 Report for chronic exposure to pulsed radiation. Pulsed radiation is the type of radiation that Smart Meters and Smart Appliances emit. The top of this line is located at 0.006 milliwatts per square meter (mW/m²). The bottom of this line is located at 0.003 milliwatts per square meter (mW/m²).²⁹

New Biologically Based RF Exposure Limits Proposed in the BioInitiative 2012 Report³⁰ (as expressed, equivalently, in various units of measure)

0.3 to 0.6	nanowatts per square centimeter (nW/cm ²)	(units used in BioInitiative 2012)
0.003 to 0.006	milliwatts per square meter (mW/m ²)	(units used in appended Chart)
3 to 6	microwatts per square meter (μW/m ²)	

The data from the 67 studies in the Biological Effects Chart indicate why this level might have been judged appropriate by the authors of the BioInitiative 2012 Report: This level would protect against the biological effects found by all but five of the 67 studies. The BioInitiative 2012 Report indicates that these proposed new limits “may need to change in the future, as new and better studies are completed.”³¹ Note that this level, which can also be expressed as 3 to 6 microwatts per square meter (μW/m²), is in agreement with the level of 5 microwatts per square meter (μW/m²) proposed by Dietrich Klinghardt, M.D., Ph.D., in his detailed video treatment of the health hazards of Smart Meters.³²

²⁸ Questions and Answers about Biological Effects and Potential Hazards of Radiofrequency Electromagnetic Fields, OET (Office of Engineering and Technology) Bulletin 56, Fourth Edition, Federal Communications Commission, August 1999. See Table 1(B), Limits for General Population/Uncontrolled Exposure, page 15.

(http://www.fcc.gov/Bureaus/Engineering_Technology/Documents/bulletins/oet56/oet56e4.pdf)

²⁹ BioInitiative 2012 Report cited in footnote 2 on page 1, Section 1, Summary for the Public and Conclusions, 2012 Supplement: Summary for the Public – Ms. Sage, pages 25-26.

³⁰ 1 milliwatt (mW) is one thousandth of a watt (W). 1 microwatt (μW) is one millionth of a watt (W). 1 nanowatt (nW) is one billionth of a watt (W). 1 centimeter (cm) is one hundredth of a meter (m). So, 1 square centimeter (cm²) is one ten thousandth of 1 square meter (m²).

³¹ See footnote 29 above.

³² Dr. Klinghardt’s video, and further information about him, can be found on the following web sites:

(<http://marylandsmartmeterawareness.org/smart-meter-news/dr-dietrich-klinghardt-smart-meters-emr-the-health-crisis-of-our-time>) and (<http://www.klinghardtacademy.com/BioData/Dr-Dietrich-Klinghardt.html>).

The Thin Horizontal Green Lines on the Biological Effects Chart

The four thin horizontal green lines show the power density of the RF radiation emitted by a Smart Meter at four different distances. To determine these levels, I assumed that the Smart Meter is the type being installed in Maryland, as described in footnote 11 on page 3:

P = RF power output = 1 watt

g = antenna gain = 4 dBi = 2.5 (a pure number, a ratio)³³

This Smart Meter has an RF power output, P , of approximately 1 watt. The antenna used in the Smart Meter is a variation of a vertical dipole antenna which provides a gain, g , of 4 dBi, or 2.5, in the horizontal direction. I have not accounted for absorption by obstructions, such as walls and other objects, which can lower RF power density levels. Nor have I accounted for reflections from walls or other objects, which can raise or lower RF power density levels. So the actual power densities would likely fall somewhere between the two extremes that could apply if these other factors had been considered. The RF power density, P_D , in watts per square meter (W/m^2) can be calculated from this equation:

$$P_D = g \left[\frac{P}{4\pi r^2} \right]$$

In the above equation, r is the distance, in meters, from the Smart Meter, in the horizontal direction. This equation can be understood this way: The radiation from the Smart Meter travels outward from the meter and is initially regarded as spreading uniformly over the surface of a sphere (centered on the Smart Meter) which has a radius, r , and thus a surface area of $4\pi r^2$. So the part of the equation in square brackets [] indicates the power density that would be produced, at a distance, r , if the radiation from the Smart Meter spread uniformly over the surface of that sphere. The antenna used in the Smart Meter increases the power density in the horizontal direction, at the expense of a decrease in the power density in the vertical direction, because all receivers of interest are in the horizontal direction. Those receivers include the antennas of the electric power company and the antennas of other Smart Meters in the area with which a given Smart Meter communicates. The antenna gain, g , accounts for this characteristic of the antenna and causes P_D to represent the power density in the horizontal direction.

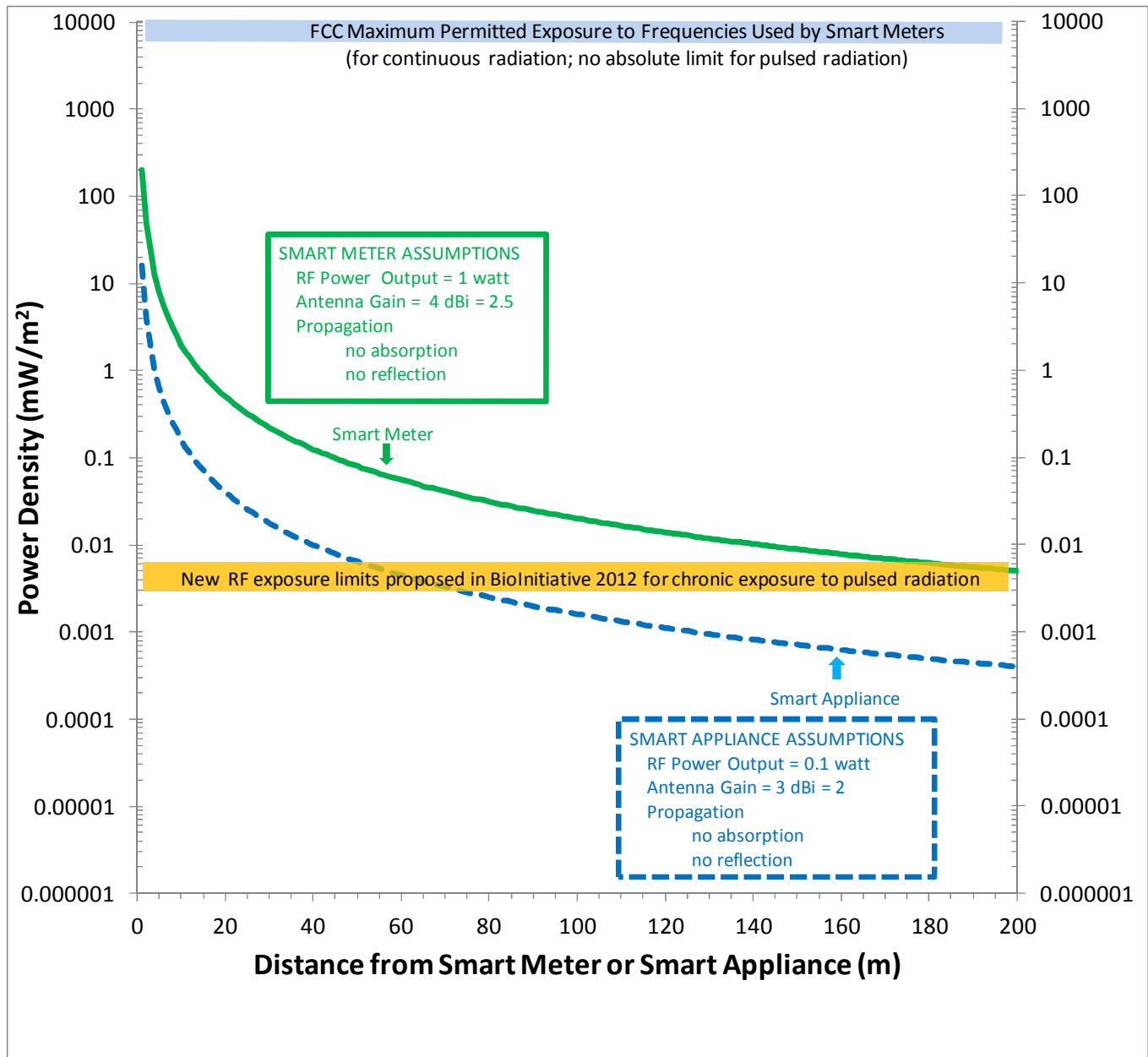
The RF power density, P_D , computed from the above equation is plotted in Figure 1 on page 9 as a function of the distance from the Smart Meter. The power density is expressed in units of milliwatts per square meter (mW/m^2) to match the units in the Biological Effects Chart under discussion. A logarithmic vertical axis is used for the power density, again to match the logarithmic vertical axis of the Biological Effects Chart. The vertical axis appears on both sides of Figure 1 to facilitate easier reading.

The power density is strongest near the Smart Meter and falls off quickly with increasing distance, but persists at lower levels to great distances. The power density of the Smart Meter drops to the maximum

³³ The antenna gain, g , is usually specified in dBi, which means the gain, in decibels, relative to an ideal isotropic antenna, which is an idealized antenna that radiates equally in all directions. The gain of the antenna in a Smart Meter (with FCC ID OWS-NIC514) is 4 dBi and translates to a factor of 2.5. That is, the power density in the horizontal direction is 2.5 times greater than it would be if the antenna radiated equally in all directions. In the case of Smart Meters, the power density in the vertical direction is reduced in favor of increased power density in the horizontal direction where all intended receivers are located. To access the reference, start at (<http://transition.fcc.gov/oet/ea/fccid>). In the box Grantee Code, enter OWS. In the box Product Code, enter -NIC514 (including the hyphen), press Search, click on the first entry Detail, and click on Test Report. This should take you to this location (<https://apps.fcc.gov/eas/GetApplicationAttachment.html?id=1174749>) which you cannot address directly. Then see page 3 of 66 of the document found.

exposure level proposed in the BioInitiative 2012 Report at a distance of about 180 meters. On the appended Biological Effects Chart, the four thin horizontal green lines show the power densities, taken from Figure 1, for distances of 1 meter (3 feet), 5 meters (16 feet), 20 meters (66 feet), and 100 meters (328 feet).

Figure 1: Smart Meter and Smart Appliance RF Power Densities versus Distance



The Thin Dashed Horizontal Blue Lines on the Biological Effects Chart

Smart Meters are designed to communicate wirelessly with new Smart Appliances that are now becoming available. The Smart Appliances contain RF transmitters and receivers of their own. Through the Smart Meters, the Smart Appliances can report, to the electric power company, data sufficient to identify the specific appliances and to indicate when they were installed or removed, and how much power they are

consuming throughout the day and the night, every day of the year. Less certain is whether the electric power company will be able to turn off the Smart Appliances by sending a wireless signal to them through the Smart Meter. (For example, the electric power company might want to turn off appliances that draw a lot of electricity at certain times of day, and in certain seasons, when the load on the electric power system is high. An example would be turning off the air-conditioner at midday in midsummer.)

Such Smart Appliances will increase the RF radiation inside each home. Verifiable data on the actual RF power output of the transmitters that will be used in the Smart Appliances is hard to find at present; but a likely value is 0.1 watt, since that is a common value used for other short-range wireless devices.³⁴ The antenna gain is assumed to be 3 dBi or 2.³⁵ The frequency of operation is assumed to be 2.4 GHz to communicate with the Smart Meters.³⁶

The RF power density for Smart Appliances is calculated with the same equation used for Smart Meters above but with the different values for P and g just cited:

$$P = \text{RF power output} = 0.1 \text{ watt}$$

$$g = \text{antenna gain} = 3 \text{ dBi} = 2 \text{ (a pure number, a ratio)}$$

The result for a single Smart Appliance is shown by the dashed blue line in Figure 1 on page 9. Once again, I have not accounted for absorption and reflection during propagation. Absorption can lower the power density. Reflection can lower or raise the power density. So the power densities shown in Figure 1 would likely fall somewhere between the two extremes that could apply if these other factors had been considered. The patterns of absorption and reflection inside homes vary greatly, so many different situations are possible.

The power density from a single Smart Appliance does not fall to the new maximum exposure level proposed in the BioInitiative 2012 Report until a distance of 50 meters (164 feet) from the Smart Appliance has been reached. So there will be no location within the typical home that will be that far from a Smart Appliance. Of course, over time, many such Smart Appliances may be purchased for a home, multiplying the total exposure produced.

In the appended Biological Effects Chart, the thin dashed blue lines show the RF power density, taken from Figure 1, for a single Smart Appliance at three distances: 1 meter (3 feet), 3 meters (10 feet), and 10 meters (33 feet) from the Smart Appliance. 10 meters is about as far from a Smart Appliance as a person can get inside the typical home with a single centrally located Smart Appliance.

³⁴ The most likely transmitter/receiver in the Smart Appliances is the so-called ZigBee device. These devices have RF outputs ranging from 0.001 watt to 0.1 watt, which is equivalent to a range of 1 milliwatt (mW) to 100 milliwatts (mW).

(<https://en.wikipedia.org/wiki/ZigBee>)

³⁵ The assumed gain, g , in this case, is 3 dBi, which is based on the performance of an ordinary vertical dipole antenna. That is, the power density in the horizontal direction is 2 times greater than it would be if the antenna radiated equally in all directions.

³⁶ ZigBee devices operate at 865 (in Europe) and 915 MHz (in the USA and Australia), as well as 2.4 GHz (worldwide); but the design of the Smart Meters installed in Maryland seems to require that the ZigBee devices operate at 2.4 GHz.

(<https://en.wikipedia.org/wiki/ZigBee>)

Conclusions and Observations

Current FCC Maximum Permitted Exposure (MPE) Limits Are Too High to Protect the Public

Because the FCC Maximum Permitted Exposure (MPE) limits are at power densities higher than the power densities addressed in all of the 67 studies, those limits provide no protection against the biological effects found in any of the 67 studies, no matter what the source of the RF radiation.

Further, the FCC Maximum Permitted Exposure limits apply to each source of radiation, individually, not to the combined exposure from all sources. But a person will generally be exposed to radiation from a combination of sources. So the FCC Maximum Permitted Exposure limits not only are too high to protect a person from a single source of radiation, but also do not consider the actual exposure received by a person from multiple sources of radiation.

New Biologically Based RF Exposure Limits, Proposed in the BioInitiative 2012 Report, are 1 Million Times Lower than the FCC Limits, to Protect the Public

The new RF exposure limits proposed in the BioInitiative 2012 Report are about 1 million times lower (stricter) than the current FCC Maximum Permitted Exposure Limits in the frequency ranges at which Smart Meters, Collector Smart Meters, and Smart Appliances operate.

Comparison of RF Exposure Limits

BioInitiative 2012 Report (RF)	FCC MPE (850 to 2400 MHz)	Ratio (FCC/BioInitiative 2012)
.003 to .006 mW/m ²	5700 to 10,000 mW/m ²	950,000 to 3,000,000

As shown in the appended Biological Effects Chart, the new RF exposure limits in the BioInitiative 2012 Report are low enough to protect against the biological effects found in nearly all of the 67 studies covered by that Chart.

A Single Smart Meter Can Produce RF Power Density Levels Shown to Cause Biological Effects

The Biological Effects Chart enables a comparison between the RF power densities produced by a Smart Meter, at various distances from that Smart Meter, and the RF power densities that triggered biological effects in the 67 studies.

The power density at 1 meter (3 feet) from a Smart Meter is higher than the power density that triggered biological effects in 50 of the 67 studies.

The power density at 5 meters (16 feet) from a Smart Meter is higher than the power density that triggered biological effects in 26 of the 67 studies.

The power density at 20 meters (66 feet) from a Smart Meter is higher than the power density that triggered biological effects in 14 of the 67 studies.

This distance of 20 meters is likely as far from a Smart Meter as a person can get and still be inside the typical home. So living and sleeping on the side of a home that is farthest from the Smart Meter is helpful but still may not reduce the received power densities to biological insignificance. Further, one or more of the neighbors' Smart Meters may be closer and may thus be the stronger source.

The power density at 100 meters (328 feet) from a Smart Meter is higher than the power density that triggered biological effects in 6 of the 67 studies.

So, even at the distance of a football field from the Smart Meter, the power density received may still be biologically significant.

As shown in Figure 1, the RF power density from a Smart Meter does not drop down to the level of the proposed new RF exposure limits until distances of 180 to 200 meters from the Smart Meter are reached. In most residential communities, whether composed of single-family homes, townhomes, or apartments, it will not be possible to get sufficiently far away from *all* of the Smart Meters present in that community.

A Single Smart Appliance inside a Home Can Produce RF Power Density Levels Shown to Cause Biological Effects

Unfortunately, the problem of excess exposure to RF radiation will get worse as Smart Appliances are adopted. They contain their own internal RF transmitters and receivers. Those Smart Appliances are designed to communicate with Smart Meters and to report through the Smart Meters to the electric power company. The data the Smart Appliances report will be sufficient for the electric power company to identify which appliances you own, when you use them, and how much power they consume, throughout the day and the night. The electric power company may even be able to turn the Smart Appliances off by sending a wireless signal to the Smart Meter that is then transferred to the Smart Appliances, but that is less certain at this time.

When these Smart Appliances are installed in a home, they will significantly increase the radiation levels in that home for several reasons:

They will begin transmitting, and from distances very close to the residents.

The number of Smart Appliances in the home may increase with time as the residents gradually replace their old appliances with new Smart Appliances, increasing the total radiation level.

The Smart Meters will transmit more frequently, in order to communicate with the Smart Appliances.

Even a single Smart Appliance can produce RF power densities of concern. An inspection of the appended Biological Effects Chart indicates the following:

The power density at 1 meter (3 feet) from a Smart Appliance is higher than the power density that triggered biological effects in 32 of the 67 studies.

The power density at 3 meters (10 feet) from a Smart Appliance is higher than the power density

that triggered biological effects in 21 of the 67 studies.

The power density at 10 meters (33 feet) from a Smart Appliance is higher than the power density that triggered biological effects in 10 of the 67 studies.

These observations do not bode well for having 5, 10, or 15 Smart Appliances in a home. The RF radiation from even a few Smart Appliances, because they will be so close to the residents, may rival that of a home's more distant Smart Meter. And the RF radiation from a large number of Smart Appliances may exceed that of a home's Smart Meter.

A Single Smart Meter on a Neighbor's Home Can Produce RF Power Density Levels Shown to Cause Biological Effects

For some locations in a given home, the distance to a neighbor's Smart Meter may be less than the distance to the resident's own Smart Meter. Thus, a neighbor's Smart Meter may be the principal source of radiation for some locations in the given home. The Biological Effects Chart shows that a single Smart Meter can produce RF power densities found to cause biological effects even at distances greater than 20 meters, and certainly up to 100 meters. And the number of neighbors within that range can be large. A given single-family home in a residential community may have one to eight nearest neighbors, and even more next nearest neighbors, all within 100 meters (328 feet) of a given home, and each with a Smart Meter.

The problem of exposure from the neighbors' Smart Meters becomes more serious as the distances between adjacent homes, and thus the distances between adjacent Smart Meters, get smaller. So, generally speaking, residents of townhouses will receive more radiation from their neighbors' Smart Meters than residents of single-family homes. And residents of apartments will receive even more radiation from their neighbors' Smart Meters, depending on the location of the Smart Meters in the apartment buildings.

So Smart Meters are a community concern, not just an individual concern. To resolve the problems of RF exposure for a given home, it will be necessary to address all of the Smart Meters near that home. Smart Appliances, too, contribute to this concern. While, individually, they have a lower RF power output than a Smart Meter, the Smart Appliances of neighbors can also increase the RF exposure in the given home.

Fortunately, some states have offered an individual OPT OUT from the installation of a Smart Meter.³⁷ While such an OPT OUT is very helpful, and is definitely the **vital first step**, the data on biological effects discussed here suggest the limitations of such an OPT OUT in resolving the problem of excess radiation from Smart Meters. There is no substitute for a roll back of all Smart Meters at the community level, or higher.

Most Biological Effects of RF Radiation Cannot be Sensed by Human Beings

Most biological effects of RF radiation cannot be sensed by human beings. This fact is evident from an inspection of the categories of biological effects from the RF Color Charts in the BioInitiative 2012 Report, as shown below. For example, humans cannot sense the onset of cancer, DNA damage, or fertility effects.

³⁷ Maryland, through the Maryland Public Service Commission, currently offers a temporary OPT OUT, with the future of that OPT OUT yet to be decided. And the Maryland House of Delegates is currently considering legislation (HB1038) that would make the OPT OUT permanent and would provide other protections for Maryland homeowners.

Categories of Biological Effects in the RF Color Charts of the BioInitiative 2012 Report

Code	Code Translation	Biological Effects Category
CB	Cancer, Brain	Brain tumors and blood-brain barrier
CO	Cancer, Other	Cancer (other than brain), cell proliferation
H	Heart	Cardiac, heart muscle, blood-pressure, vascular effects
MC	Metabolism, Calcium	Disrupted calcium metabolism
OD	Oxidation, DNA	Oxidative damage/ROS/DNA damage/DNA repair failure
R	Reproduction	Reproduction/fertility effects
S	Sleep	Sleep, neuron firing rate, EEG, memory, learning, behavior
SI	Stress, Immune	Stress proteins, HSP, ³⁸ disrupted immune function

The principal category of biological effects that humans *can* often sense is the S (or Sleep) category. This category includes neurological effects on sleep, memory, learning, and behavior, among others. Unfortunately, not sensing these particular effects does not guarantee that other biological effects are not occurring.

RF Radiation May Affect Unborn and Very Young Children More Severely than Adults

The BioInitiative 2012 Report presents evidence that unborn and very young children may be more greatly affected by RF radiation than adults because unborn and very young children are in “critical phases of growth and development”.³⁹

Concern for unborn and very young children is shared by the American Academy of Pediatrics (AAP) which wrote to the U.S. Congress in support of a bill before the U.S. House of Representatives (H.R. 6358).⁴⁰ This bill would fund development of better founded RF exposure limits to protect against cell phones and other wireless sources of RF radiation. The AAP made the following statement:

*The AAP strongly supports H.R. 6358’s emphasis on examining the effects of radiofrequency (RF) energy on vulnerable populations, including children and pregnant women. In addition, we are pleased that the bill would require the consideration of those effects when developing maximum exposure standards. Children are disproportionately affected by environmental exposures, including cell phone radiation. The differences in bone density and the amount of fluid in a child’s brain compared to an adult’s brain could allow children to absorb greater quantities of RF energy deeper into their brains than adults. It is essential that any new standards for cell phones or other wireless devices be based on protecting the youngest and most vulnerable populations to ensure they are safeguarded through their lifetimes.*⁴¹

³⁸ HSP stands for Heat Shock Proteins. BioInitiative 2012 Report, cited in footnote 2 on page 1, Section 1, Summary for the Public and Conclusions, Table 1-2 Reported Biological Effects from Radiofrequency Radiation at Low-Intensity Exposure 2012, no page numbers.

³⁹ BioInitiative 2012 Report cited in footnote 2 on page 1, Section 1: Summary for the Public and Conclusions, 2012 Supplement: Summary for the Public – Ms. Sage, pages 8-10.

⁴⁰ Summary of H.R. 6358 can be found here:

(<http://marylandsmartmeterawareness.org/smart-meter-news/ask-your-congressional-rep-to-co-sponsor-h-r-6358>). Full copy of H.R. 6358 can be found here: (http://thomas.loc.gov/home/gpoxmlc112/h6358_ih.xml).

⁴¹ (http://ehtrust.org/wp-content/uploads/2012/12/aap_support_letter_cell_phone_right_to_know_act.pdf)

Smart Meters and Smart Appliances operate in the same frequency ranges as cell phones. Further, Smart Meters have twice the RF power output of the typical cell phone, as shown in the table below, and will be transmitting day and night. Emerging Smart Appliances will likely have about one-fifth the RF power output of the typical cell phone. But a given home may have several Smart Appliances; and they, too, will be transmitting day and night.

Device	RF Power Output				
Smart Meter ⁴²	1.115	watts	which is	1115	milliwatts
Typical leakage from a microwave oven ⁴³	1	watt	which is	1000	milliwatts
Typical cell phone ⁴³	0.5	watt	which is	500	milliwatts
Wireless LAN (802.11a) ⁴³	0.251	watt	which is	251	milliwatts
Wireless LAN (802.11n) ⁴³	0.250	watt	which is	250	milliwatts
Cordless phone ⁴⁴	0.230	watt	which is	230	milliwatts
Smart Appliance ⁴⁵	0.100	watt	which is	100	milliwatts
Wireless LAN (802.11 b, g) ⁴³	0.100	watt	which is	100	milliwatts
Typical laptop wireless LAN (Wi-Fi) ⁴³	0.032	watt	which is	32	milliwatts

A Final Note

The Smart Meter is the first source of RF exposure that is mandated for installation in every home in an entire region without the informed consent, or any consent, of the residents, and that is not under the control of the residents.

For other sources of RF exposure in the home, the residents have a choice to use them, or not to use them, and how often, and how long. Some of those other sources are included in the table above.

The Smart Appliances, while not mandated, will be the second source of RF exposure in a home that is not under the control of the residents -- if manufacturers of the Smart Appliances provide no way of turning off the RF transmitters in those appliances.

The only solution for the individual homeowner, at present, is the removal of the Smart Meter and the avoidance of the Smart Appliances. This is a vital first step; but it is only a partial solution for a given home, because the radiation from the neighbors' Smart Meters and Smart Appliances will cross property boundaries. Collaboration with the neighbors on reducing exposure levels is needed; and a solution at the community level, or higher, will be even more effective.

⁴² The Landis+Gyr FOCUS AXR-SD and the General Electric I-210+c, being installed in Maryland, have FCC-ID OWS-NIC514 which indicates that they send and receive information in two microwave frequency ranges: (1) 902.3 to 926.9 MHz, and (2) 2405.8 to 2480.9 MHz. The RF power output in the first frequency range is 0.968 watts. The RF power output in the second frequency range is 0.147 watt. These values sum to the 1.115 watts shown here, to provide an indication of the total RF power output capability of a Smart Meter. I have used an approximate value of 1 watt for the RF power output of a Smart Meter throughout this document (<http://stopsmartmeters.org/wp-content/uploads/2012/01/OWS-NIC514-FCC-specifications.pdf>).

⁴³ The RF power output levels come from this web site: (<http://en.wikipedia.org/wiki/DBm>). 1 watt equals 1000 milliwatts.

⁴⁴ Panasonic specifies the power output of its DECT 6.0 cordless telephone Model KXTG1061 as 115 milliwatts for the handset and another 115 milliwatts for the base station, for a total capability of 230 milliwatts.

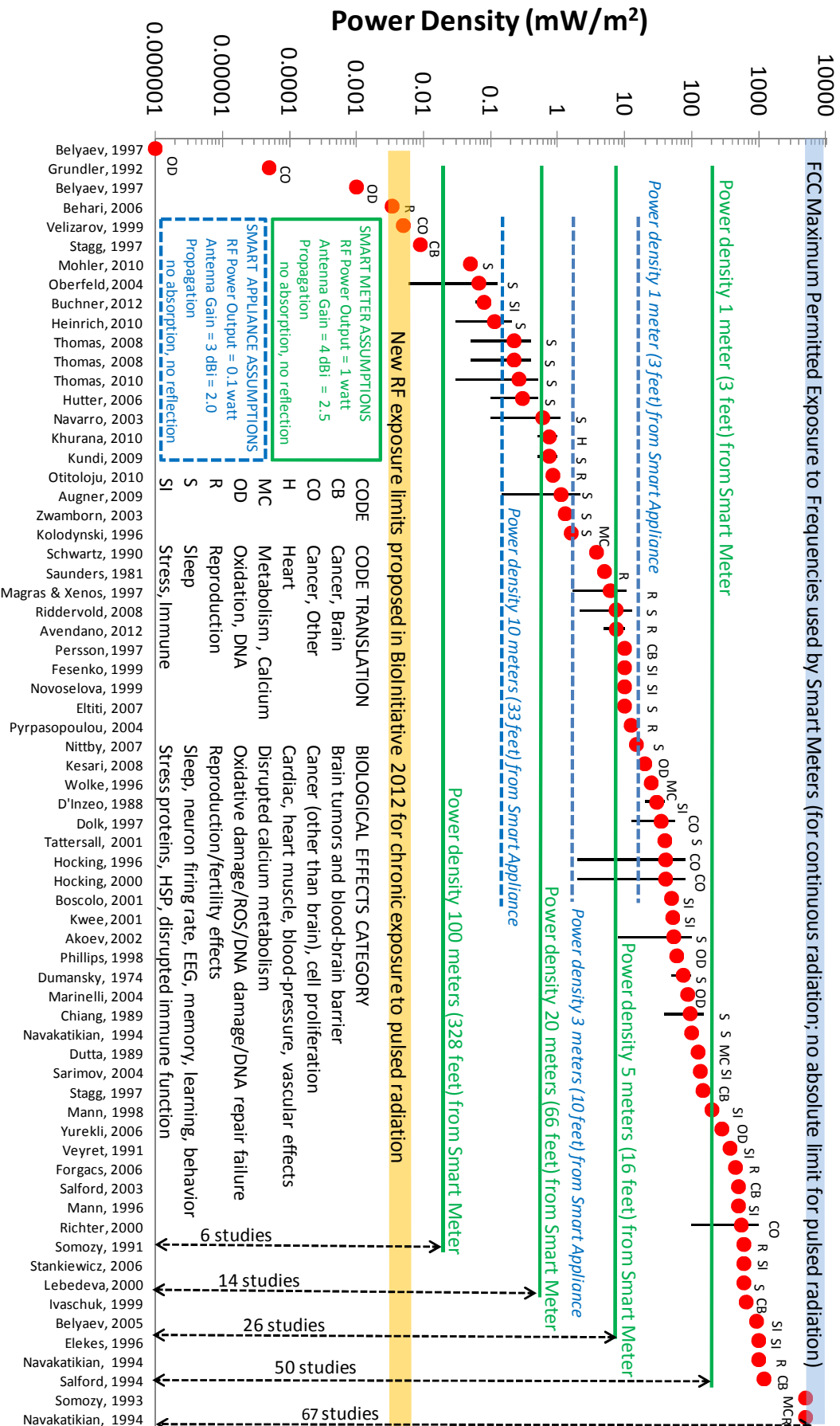
⁴⁵ For a reference, see footnote 34 on page 10.

June 11, 2013

Reported Biological Effects from RF Radiation at Low-Intensity Exposure in Each of the 67 Studies Referenced in the "BioInitiative 2012" Report (Cell Tower, Wi-Fi, Wireless Laptop, and Smart Meter Power Densities)

Ronald M. Powell, Ph.D.

Reference for data dots (red), data range indicators (vertical black lines through red dots), biological effects categories for the red dots, and new proposed limits (yellow line): BioInitiative Working Group, Cindy Sage and David O. Carpenter, Editors. BioInitiative Report: A Rationale for Biologically-based Public Exposure Standards for Electromagnetic Radiation at www.bioinitiative.org, December 31, 2012. For references for other information on this chart, including the FCC Maximum Permitted Exposure limits, and the power densities of Smart Meters and Smart Appliances, see accompanying paper.



Eng. Lawrence James Gust Comments, Aug. 20, 2013

FCC 13-39

**Before the
Federal Communications Commission
Washington, D.C. 20554**

In the Matter of)	
)	
Reassessment of Federal Communications)	ET Docket No. 13-84
Commission Radiofrequency Exposure Limits and)	
Policies)	
)	
Proposed Changes in the Commission's Rules)	ET Docket No. 03-137
Regarding Human Exposure to Radiofrequency)	
Electromagnetic Fields)	
)	

To: Office of the Secretary
Federal Communications Commission
Washington, DC 20554

Comment Filed by: Lawrence J Gust
211 S. Brent St
(Ventura, CA, 93003
larry@phliving.com
805-644-2008

August 20, 2013

AFFIDAVIT OF (your name) LAWRENCE JAMES GUST

State of California

Ventura County

I, Lawrence James Gust, attest that my statements are true to the best of my knowledge.

Comment round for FCC ET Docket No. 013-84 and ET Docket No. 03-137

1. My name is Lawrence James Gust . My address is 211 S Brent St, Ventura, CA
2. I am an electrical engineer and a certified Building Biology Environmental Consultant.
3. My statement follows on pages 3 and 4

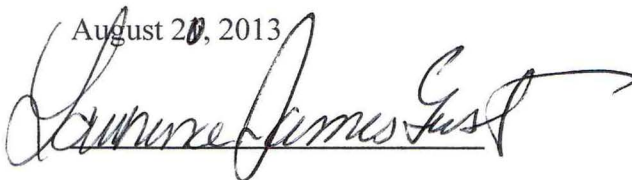
Respectfully submitted by

Lawrence James Gust

211 S. Brent St.

Ventura, CA, 93003

August 20, 2013



(your signature)

(should you so choose)

Sworn to before me

This 20 day of Aug, 2013


Notary Public



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Monday, August 19, 2013

Federal Communications Commission
Washington, DC

Comments for Dockets - ET Docket No. 03-137 and ET Docket No. 13-84.

My name is Lawrence J. Gust, Ventura, CA. I am a degreed electrical engineer with an MBA. I have been an environmental consultant for 20 years working through doctors with patients suffering from multiple chemical sensitivities and electrical Hyper Sensitivity. In these cases the doctor believes that the patient's home plays a role in their illness or in their inability to respond to treatment.

I would like to remind the FCC of the Federal court's decision in In 1965, dealing with a this federal agency's responsibility to protect the environment (Scenic Hudson v. Federal Power Commission) in which the court said:

- If the Commission is properly to discharge its duty in this regards, the record on which it bases its determination must be complete. The petitioners and the public at large have a right to demand this completeness. It is our view, and we find, that the Commission has failed to compile a record which is sufficient to support its decision. The Commission has ignored certain relevant factors and failed to make a thorough study of possible alternatives . . .
- . . . the public is entitled to know on the record that no stone has been left unturned.
- The Commission of its own motion, should always seek to insure that a full and adequate record is presented to it.
- A regulatory commission can insure continuing confidence in its decisions only when it has used its staff and its own expertise in manner not possible for the uninformed and poorly financed public.
- The Commission must see to it that the record is complete. The Commission has an affirmative duty to inquire into and consider all relevant facts.

Over my 20 year career in this field, the instances of people with Electromagnetic Hyper Sensitivity Syndrome (EHS) has increased from nearly zero to more than 50% of my practice. There is no factor that can so fully account for this dramatic increase across such a broad population other than the increase in man-made electromagnetic radiation now millions of times greater than it was 20 years ago.

Just to be clear EHS is also referred to as Idiopathic environmental intolerance to electromagnetic fields. Sufferers of electromagnetic hypersensitivity report responding to non-ionizing electromagnetic fields (or electromagnetic radiation) at intensities well below the limits permitted by international radiation safety standards.

Page 3/4

Electrical Engineer

Certified Electromagnetic Radiation Safety Advisor

Certified Building Biological and Ecology Consultant

Member, National Electromagnetic Field Testing Association

Faculty and Board of the International Institute for Building Biology and Ecology, Inc.

JA 04133

The client reported symptoms of EHS include severe and frequent headache, fatigue, stress, sleep disturbances, skin symptoms like prickling, burning sensations and rashes, pain and ache in muscles, digestive disturbances and many other health problems. EHS symptoms are a real and sometimes disabling problem for the affected persons.

When I have been called into such cases, measurements of RF radiation has shown power density levels significantly below levels now set by FCC regulations. However, the power density levels in these cases are above levels described in peer reviewed research looking at cellular level affects of RF radiation. These studies are cited in the *2012 Bio-Initiative Report* which is appended to this statement.

Many of the patients I deal with had no history of sensitivity to chemicals or EMF including RF prior to the onset of some initial sensitizing RF event. These people led what would be described as normal lives in middle class and upper middle class surroundings. The most frequent initial sensitizing event over the last two years has been the installation of a power company smart meter.

The human dimension of EHS is tragic. I have people calling me in ever increasing numbers reporting the total change in their life circumstances and begging me for help to return to a normal life. These people are enduring enormous suffering. They have very painful, frequent headaches; they have burning skin; they have heart arrhythmia; they have pain in extremities; they have mental confusion; they have memory loss. They have lost their unalienable rights...

"We hold these truths to be self-evident, that all men are created equal, that they are endowed by their Creator with certain unalienable Rights, that among these are Life, Liberty and the pursuit of Happiness.--That to secure these rights, Governments are instituted among Men, deriving their just powers from the consent of the governed."

My clients are unable to work because places of employment are loaded with wireless devices. They are unable to drive to work because the roadways are flanked by cell phone towers irradiating passing vehicles with significantly high levels of RF compared to studies on cellular level effects. They are unable to live in urban and suburban areas of California as houses are being irradiated by ever increasing numbers of cell phone antennas, utility smart meters and neighbor's wireless devices.

More to the point, when remediation was done to reduced RF radiation through shielding of the residence, symptoms were abated or reduced depending on the initial power density and the overall ability of the shielding plan to obtain significant reduction in RF. The ability to reduce RF enough to be effective is a costly process and economic constraints prevent many people from effecting the best remediation plan or any plan at all.

Finally, I am greatly concerned about the 4G cell phone system as the frequencies envisioned for this service go as high as 8 GHz, more than four time the current maximum frequency. The four fold reduction in wave length will significantly reduce the effectiveness of some types of already installed shielding. This situation will adversely affect people who have already paid thousands of dollars for shield to provide themselves with some measure of relief from the health problem brought on by their original exposure.

Respectfully Submitted this 19th day of August, 2013,

Lawrence James Gust
Ventura, CA



BioInitiative 2012

A Rationale for Biologically-based Exposure Standards for Low-Intensity Electromagnetic Radiation

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Cite this report as: BioInitiative Working Group, Cindy Sage and David O. Carpenter, Editors.
BioInitiative Report: A Rationale for Biologically-based Public Exposure Standards for Electromagnetic Radiation at
www.bioinitiative.org, December 31, 2012

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PREFACE

The Organizing Committee thanks the participants of the BioInitiative Working Group for their integrity and intellectual courage in dealing with this controversial and important topic; and for devoting the time and energy to produce their chapters. The information and conclusions in each chapter are the responsibilities of the authors of that chapter.


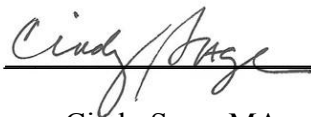
The Group has produced what the authors hope will be a benchmark for good science and public health policy planning. It documents bioeffects, adverse health effects and public health conclusions about impacts of non-ionizing radiation (electromagnetic fields including extremely-low frequency ELF-EMF and radiofrequency/microwave or RF-EMF fields).

Societal decisions about this body of science have global implications. Good public health policy depends on acting soon enough, but not without cause, and with enough information to guide intelligent actions. To a great degree, it is the definition of the standard of evidence used to judge the scientific reports that shapes this debate. Disagreement about when the evidence is sufficient to take action has more to do with the outcome of various reviews and standard-setting proceedings than any other single factor. Whatever “standard of evidence” is selected to assess the strength of the science will deeply influence the outcome of decisions on public policy.

We are at a critical juncture in this world-wide debate. The answers lie not only in the various branches of science; but necessarily depend on the involvement of public health and policy professionals, the regulatory, legal and environmental protection sectors, and the public sector.

This has been a long-term collaboration of international scientists employing a multi-disciplinary approach to problem assessment and solving. Our work has necessarily relied on tools and approaches across the physical, biological and engineering sciences; and those of the environmental scientist and public health professional. Only when taken

together can we see the whole and begin to take steps that can prevent possible harm and protect future generations.

Signed:  Signed: 
David Carpenter, MD
Co-Editor
BioInitiative Report
Cindy Sage, MA
Co-Editor
BioInitiative Report

Eng. Michael Schwaebe Comments, Feb. 23, 2013

CALIFORNIA ALL-PURPOSE ACKNOWLEDGMENT

State of California

County of

San DiegoOn September 3, 2013 before me, Elizabeth Etienne, Notary Public

personally appeared

Michael J. Schwaabe
Name(s) of Signer(s)

who proved to me on the basis of satisfactory evidence to be the person~~(s)~~ whose name~~(s)~~ is subscribed to the within instrument and acknowledged to me that ~~he/she/they~~ executed the same in his/~~her~~/their authorized capacity~~(ies)~~, and that by his/~~her~~/their signature~~(s)~~ on the instrument the person~~(s)~~, or the entity upon behalf of which the person~~(s)~~ acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

Signature

Elizabeth Etienne
Signature of Notary Public

Place Notary Seal and/or Stamp Above

OPTIONAL

Though the information below is not required by law, it may prove valuable to persons relying on the document and could prevent fraudulent removal and reattachment of this form to another document.

Description of Attached Document

Title or Type of Document:

Affidavit of Michael J. Schwaabe

Document Date:

September 2, 2013

Number of Pages:

7

Signer(s) Other Than Named Above:

Capacity(ies) Claimed by Signer(s)

Signer's Name:

Signer's Name:

☐ Corporate Officer — Title(s):☐ Corporate Officer — Title(s):☒ Individual☐ Individual☐ Partner — ☐ Limited ☐ General☐ Partner — ☐ Limited ☐ General☐ Attorney in Fact☐ Attorney in Fact☐ Trustee☐ Trustee☐ Guardian or Conservator☐ Guardian or Conservator☐ Other: _____☐ Other: _____

Signer Is Representing: _____

Signer Is Representing: _____

RIGHT THUMBPRINT
OF SIGNER

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RIGHT THUMBPRINT
OF SIGNER

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document scanned and emailed

AFFIDAVIT OF Michael J. Schwaebe

State of California

San Diego County

I, Michael Schwaebe, attest that my statements are true to the best of my knowledge.

Comment round for FCC ET Docket No. 013-84 and ET Docket No. 03-137

1. My name is Michael Schwaebe. My address is 215 Andrew Ave, Encinitas, CA 92024.
2. I am a Professional Engineer and Building Biology Environmental Consultant.
3. **Request for Exposure Limits That Protect Humans from the Biological Effects of Non-Ionizing Radiation**

In this request I'm going to tell you what I would like to see come of this rule-making. Then I am going to provide examples, in my personal experience and those of my clients, as well as examples in the science supporting my request. I include reviews of some RFR exposure limits globally, along with a reference to a current trend where insurance companies are declining to cover damage from RFR exposure. I've also included a biography so that you know from where these comments are coming, e.g., an engineer that served in USN nuclear submarines and worked at SCE's San Onofre Nuclear Generating Station.

4. What I Would Like to See in the Reassessment of RFR Exposure Limits for the General Public

- A. Acknowledge that the current thermal limits, based on a 6 minute RMS average, do not address the biological effects associated with the peak signal of our wireless devices, nor all of the research that shows biological effects as low as one millionth of the current limit.
- B. Reduction of the MPE limits to $10 \mu\text{W}/\text{cm}^2$, as is already the standard in China, India, Italy and Russia."
- C. Locate antennas and set maximum power levels in a way that minimizes effects on health and environment.
- D. Establish SAR limits that provide protection from the biological effects for all the possible users, e.g., age and size of head with handset pressed against the ear.
- E. Publish an FCC guidance document with a title something like this: "Moderating Personal Exposure (And Biological Health Effects) from Non-Ionizing Radiation Emitted by Wireless Electronic Devices."
- F. Publication of a standard that sets limits for RFR emissions from personal wireless devices, e.g. Wi-Fi, WLAN, cordless mouse, keyboard, monitor, cordless telephone, tablets, eReaders and game toys, that provides guidelines to minimize personal exposure to the devices.
- G. Establishment of an independent research fund and organization to manage RFR research.

5. Some Personal Notes on How RFR Exposure Affects Me, an Electric Sensitive Human

When standing 4 feet from the new SDG&E Itron smart meter installed on my house, with just one microburst, I would feel a ripping sensation through the back of my head and neck and then a headache that would last for hours. This Itron smart meter had a peak reading of about $0.02 \mu\text{W}/\text{cm}^2$ at a distance of 3 feet, as measured with a Gigahertz HF59B HF Analyzer. The meter has been removed and there are no wireless devices in my home now, and I am so much more comfortable. In other peoples' homes with cordless phones, or Wi-Fi/WLAN, I would get an oppressive feeling on the back of my head and shoulders, leading to headache, vision distortion, anxiety, irritability, and ringing in the ears that would continue for hours after I left. Typically these wireless devices have an RFR level of about $1-4 \mu\text{W}/\text{cm}^2$ at 2-6 feet from the devices. And I would experience these discomforting symptoms even when I was 20 feet away.

6. Radiofrequency Radiation (RFR) has Neurophysiological Effects that Impact Quality of Life, Stories about My Clients

Lorraine L. is a former Navy dentist, disabled due to chemical sensitivity. After the smart meters were installed in her neighborhood in Coronado, CA, she became electric sensitive. I saw this woman cry because she was exposed to smart meter RFR that was less than $0.02 \mu\text{W}/\text{cm}^2$.

Vicki R. developed heart arrhythmia and anxiety after living for approximately 2 years in a nice La Jolla, CA neighborhood surrounded by more than 400 antennas of different types on Soledad Mountain and at UCSD. Her home was approximately midway between the two locations. The safest place for her there was on the floor in the downstairs laundry room. She has taken up residence temporarily at another site, and her health was restored. The radiation levels in the second floor bedroom were as high as $2 \mu\text{W}/\text{cm}^2$ peak, about half being from radio and television and the other half being from mobile phone antennas.

Sue B. has been living in her 2 bedroom home in La Mesa, CA and can no longer safely occupy the master bedroom where she had slept for the past 15 years. She experiences headache, tightening of the neck and shoulders, shortening of breath and anxiety. These symptoms came on after a smart meter was placed on the power panel on her bedroom wall. The smart meter was installed about the same time that mobile antennas in her neighborhood were upgraded to 4G. The typical RFR levels outside of her bedroom are $0.2 \mu\text{W}/\text{cm}^2$ peak.

Marie T. in La Jolla, CA couldn't sleep well after the smart meter was installed on her power panel 12 feet from her bed, even though the smart meter faced outward. She also had Wi-Fi and cordless phones in her home office, with RFR levels of $1-2 \mu\text{W}/\text{cm}^2$ peak where she would sit. After the smart meter was installed she could no longer rest comfortably in her bedroom or in her home. Her health and her good sleep were restored when the smart meter was removed, the computers were hardwired and a corded phone was installed.

Anne S. in San Diego is an environmentally sensitive PhD engineer. When the family home where she had taken refuge was no longer available to her, she couldn't find an apartment or home where the RFR levels were low enough that she could comfortably sleep. Consequently, she slept in the back of her pick-up truck for 5 months, and now lives in a rural area 60 miles inland in Guatay, CA.

Ron and Nicola R., Jeff L. and John T., in Encinitas, CA all had ringing in their ears that seemed to be worse when they went to bed and experienced disturbed sleep. Their doctors could find no medical explanation for the tinnitus. All of them slept with cordless phone base stations on the bed stand, with RFR levels at 2 feet of approximately $2 \mu\text{W}/\text{cm}^2$. Their symptoms declined significantly when their cordless phones were removed.

Nicola R., in Encinitas, CA, said that when the Wi-Fi was removed from her office, she no longer had the usual headache and fatigue after working there for 6 hours there. The power density was $2.5 \mu\text{W}/\text{cm}^2$ at her chair 3' from the Wi-Fi router.

Piper L. and Sonia G. in Encinitas, CA both said that their headaches and tension went away and they could breathe easier when the Wi-Fi, located 20 feet away, was turned off.

Harrison B. is an English professor at SUNY New Paltz, NY and wears a ball cap lined with RF reflective material. If he gets too close to a Wi-Fi transmitter at the campus, he gets a sharp wedge-like pain in the right temporal area and a blinding headache. This sensitivity has led him to seek a basement classroom and cellphones and computers in the wireless mode are prohibited in his classroom.

Ken M. at the Country Acres mobile home site, in Louisville, TN and several of his tenants have had intermittent cardiac symptoms, such as arrhythmia, low or high blood pressure, and anxiety, irritability, depression, loss of libido and physical vitality that started when the local electrical cooperative installed a SCADA antenna in the middle of the property. The SCADA operates at 2.4 GHz spread frequency, with microbursts at one minute increments. Power density in the homes was approximately $1 \mu\text{W}/\text{cm}^2$ peak.

Emily R. in Media, PA went to the hospital with ketoacidosis, complications of diabetes. Emily developed tachycardia. The doctors were stumped, and this continued for several days despite medications. When her mom Judy persuaded the doctors to remove the wireless monitors, the heart rate and blood pressure returned to normal ranges, and Emily was released. All the medical monitors were wireless, the trend in our modern hospitals. That Emily's health was affected by the wireless monitors is consistent with this peer reviewed study: "Provocation study using heart rate variability shows microwave radiation from 2.4 GHz cordless phone affects autonomic nervous system", Magda Havas et al, Eur.J. Oncol. - Library Vol. 5. See http://electromagnetichealth.org/wp-content/uploads/2010/10/Havas_HRV_Ramazzini1.pdf

The RFR exposure for these clients, and many from my personal experience not noted here affects the quality of their lives. In all of these, the RFR has been less than 1% of the thermal limits.

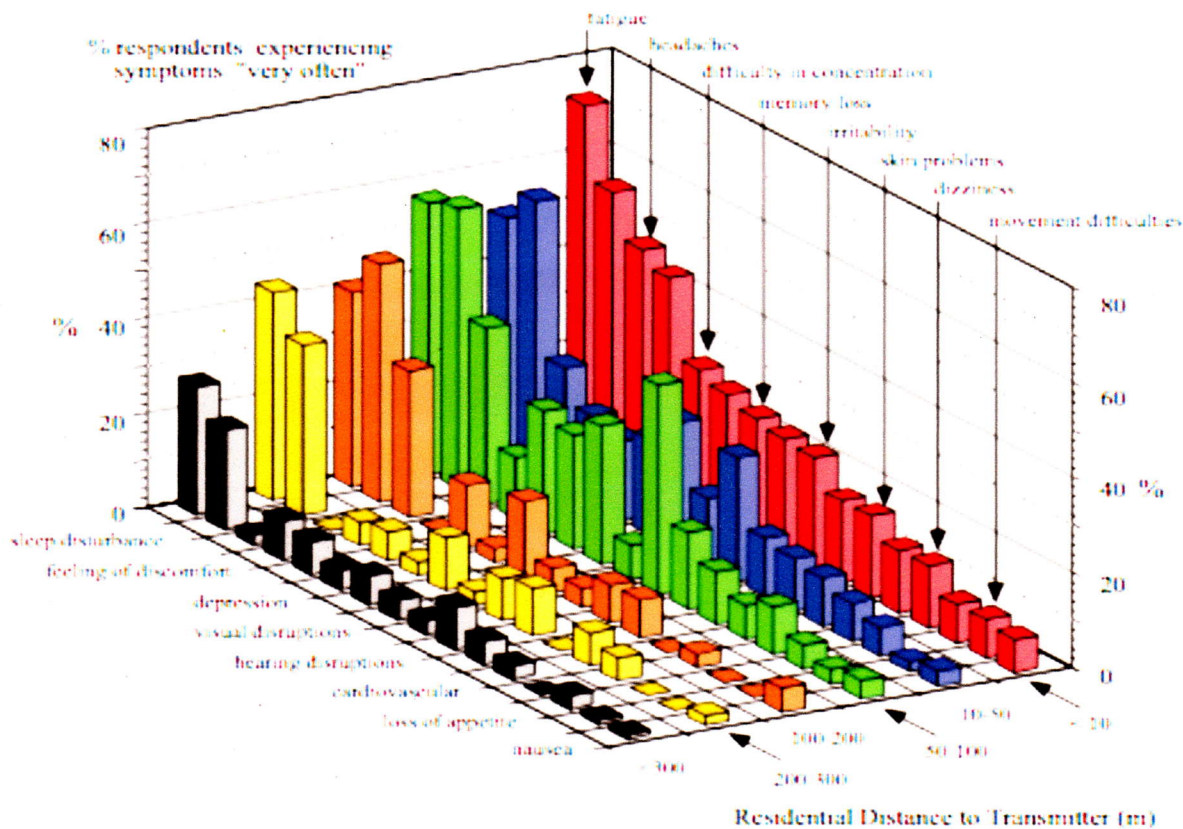
I have observed that the wireless devices that are brought into their homes and offices are often operating at 10-100 times more power than is needed to serve these areas. Often the devices are placed right next to a person, the bed, the desk. There is no guidance provided with the devices, and the host is ignorant about the biological consequences of sitting and sleeping next them.

Many of my clients tell me that they wake up at about 2 a.m. in the morning and can't get back to sleep. Many are on sleep medications. A recent study by the CDC found that 4% of American adults have recently used a prescription sleep medication, (<http://www.cdc.gov/nchs/data/databriefs/db127.htm>) According to the New York Times; Americans spend \$4.5 billion a year on such sleep aids (http://www.nytimes.com/2007/10/23/health/23drug.html?pagewanted=all&_r=0).

7. Epidemiology Study Showing Neurophysiological Effects in Proximity to Mobile Antenna

The epidemiology study by Santini et al, 2002, documented many of these affects associated with proximity to mobile antenna. A chart illustrating this is shown below. It is noteworthy that the study concluded that the health effects become significant at $0.1 \mu\text{W}/\text{cm}^2$, 1/100000 of the current RFR limit.

There is human cost for the convenience of wireless devices. For an example, the smart meters using RF communication are undoubtedly the most economical way for the utilities to implement metering technologies. However, there are human costs and health consequences, including an impaired quality of life. And ultimately, the same thing can be said of all of our wireless devices.



Frequency of Electromagnetic Hypersensitivity Symptoms Based on Distance to Cell Phone Base Station (Santini et al, 2002).

8. Some Good References to Biological Effects

RFR at low levels, e.g. less than 1% of the current FCC limit, contributes to inflammatory conditions that lead to a host of inflammatory diseases, including cancer. See “Biological effects from exposure to electromagnetic radiation emitted by cell tower base stations and other antenna arrays” by B. Blake Levitt and Henry Lai [here](https://www.researchgate.net/publication/312211110_Biological_effects_from_exposure_to_electromagnetic_radiation_emitted_by_cell_tower_base_stations_and_other_antenna_arrays):

www.nrcresearchpress.com/doi/pdf/10.1139/A10-018.

Biological effects from RFR are well documented in the Bioinitiative Report found at BioInitiative.org. At this website there are RF color charts (<http://www.bioinitiative.org/rf-color-charts/>) that show the RFR power density, biological effects and a reference citation for the following 8 categories:

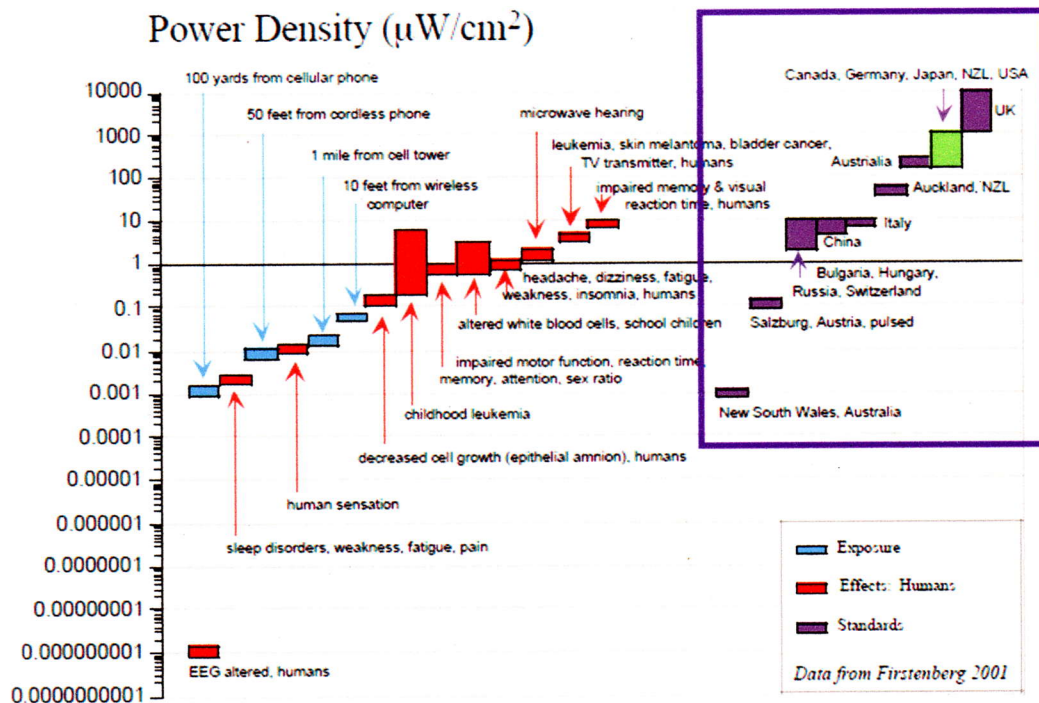
- A. Stress proteins, HSP, disrupted immune function
- B. Reproductive/fertility effects
- C. Oxidative damage/ROS/DNA damage/DNA repair failure
- D. Disruptive calcium metabolism
- E. Brain tumors and blood-brain barrier
- F. Sleep, neuron firing rate, EEG, memory, learning, behavior
- G. Cancer (other than brain), cell proliferation
- H. Cardiac, heart muscle, blood-pressure, vascular effects

There are 46 citations for RFR levels equal to or less than $10 \mu\text{W}/\text{cm}^2$, which is 1% of the FCC exposure limit for a typical mobile phone antenna. Also in these tables are 62 citations for a SAR equal to or less than 1.6 W/Kg, the current FCC limit.

9. RFR Exposure Limits around the World

China, India, Russia, and Italy have a maximum exposure limit of $10 \mu\text{W}/\text{cm}^2$, which is 1% of the FCC thermal limit. More than half of the world's population has an exposure that's less than our regulators provide in the United States. These limits are a reflection of the known science and are probably still too high to protect from biological effects that occur at very low levels. Just because we're Americans doesn't mean that we have a thicker skin that protects us from RFR.

This figure is shown on page 5 of Magda Havas' San Francisco Wi-Fi Environmental Report and illustrates guidelines for many countries. http://www.powerwatch.org.uk/pdfs/20061232_havas.pdf



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There is a global trend to moderate RFR exposure limits because the science shows that there are serious biological consequences that affect our health. At this website http://www.cellphonetaskforce.org/?page_id=128 there are more than 15 citations of major libraries, schools, organizations and government agencies that have removed Wi-Fi and or recommend that it not be used in schools. In addition, there are more than 10 citations where schools, organizations and government agencies have prohibited or recommended that cell phones not be used in the schools, or used by children.

In India mobile antennas are being removed from schools, colleges, hospitals, near jails and play grounds, apartment rooftops and more as a result of court order. See <http://www.google.com/url?sa=t&rct=j&q=israni%20%22union%20of%20india%22%20%22high%20court%22%20rajasthan&source=web&cd=5&ved=0CD4QFjAE&url=http%3A%2F%2Fwww.rtiindia.org%2Fforum%2Fattachments%2Fchit-chat%2F8595d1358495483-no-mobile-towers-near-schools-hospitals-directs-rajasthan-hc-no-mobile-towers-near-schools-hospitals-directs-rajasthan-highcourt.pdf&ei=80MeUq7ONMnkyQGJmYGwDA&usg=AFQjCNFCfNEmAnTRaTYhfxag1UQdZohJkg>

The Parliamentary Assembly of the Council of Europe in ERES 1815 has recommended numerous actions for the health of the citizens of the entire European Union (28 countries) as follows: 5 actions to reduce exposure; 4 actions to set preventive thresholds; 2 actions to protect children; 4 actions for community planning to reduce health effects; and 8 actions for risk assessments and precautions. One item of note for the current rule making is item 8.1.5, which states, "...step up research on new types of antenna, mobile phone and DECT-type device, and encourage research to develop telecommunication based on other technologies which are just as efficient but whose effects are less negative on the environment and health..."

<http://www.assembly.coe.int/Mainf.asp?link=/Documents/AdoptedText/ta11/ERES1815.htm>

10. Insurance Companies Are Taking Note of the Risks

Insurance companies, such as Lloyd's of London, are not insuring for the health effects caused by exposure to RFR (<http://www.mainecoalitiontostopsmartmeters.org/wp-content/uploads/2013/04/EV9-Insurability-Liability-Corrected-4-8-13-PUC-464.pdf>). Insurance companies, looking at the science, and doing their risk assessments, are looking out for their financial interests. This says something about the gravity of the perceived health consequences from chronic RFR exposure. The precautionary principle can really be applied now to mitigate what is ultimately coming with the current exposure limits, epidemic health challenges.

11. Conclusion

The comments above serve to illustrate, both from personal experience and the science, that RFR non-ionizing radiation has biological effects well below the current thermal limits.

It is time to acknowledge that the current thermal limits do not protect us from the biological effects associated with the radiation emitted by our wireless devices, and to take appropriate precautionary steps. Indeed, Europe and other nations in our world are setting an example for us.

We need to be protected from mobile antennas, telecommunication systems and other RFR sources that come from outside our homes, and we need to be protected from the technologies that we bring into our homes and offices.

12. Biography

- A. Education: Graduated from Oregon State University in 1969 with a Bachelor of Science degree in Mechanical Engineering (BSME). I was privileged to have a Navy scholarship for my schooling and upon graduation I was commissioned directly into the US Navy as an Ensign.
- B. US Navy ('69-'74): Engineering watch officer supervising maintenance and operation of nuclear propulsion systems. Qualified in submarines, ship's watch officer supervising maintenance and operation of ship.
- C. Solar Gas Turbine Corp. ('75-'77): Program administrator for a nationwide emergency gas turbine preventive maintenance project.
- D. Planning Research Corp (PRC) ('78-'80): Director of pre-overhaul test, inspection and planning for US Navy non-combatant surface ships.
- E. Southern California Edison, San Onofre Nuclear Generating Station (SONGS) ('81-'09)
Systems engineer, design maintenance and safe operation. I completed my certification as a Professional Engineer at SONGS in the mid 80's.
- F. Building Biology Environmental Consultant:

In 1993 I had a God knock at the power plant, a head injury where forward motion, as I had known it, stopped. A physical and mental condition arose of sensitivity to chemical, electrical, sound and subtle energies. In circa 2000, I undertook the study of Biogeometry, a tool set that empowered me to remediate the powers of nature around me so that I could be more comfortable. About 2006 remediation of the energy qualities associated with electrical was no longer enough for me to be comfortable in my skin. And it was at this time that I embarked in the Building Biology training. I did the three basic courses that year, purchased instruments, and was mentored by Larry Gust, now chairman of the board of directors for the Building Biology Institute and Martine Davis, an indoor air quality specialist. I started the work in my home, in my work place and in the homes of friends. All along, from the start of my training, I have sought out my personal sensitivities and their causes and to measure / quantify these. I was awarded a certificate as a Building Biology Environmental Consultant in mid-2011.

As a Building Biology Environmental Consultant, I bring to the task my personal instrument, honed through years of self-awareness, insight and augmented by a host of instruments. I, for the most part, feel what my clients feel. I can assess the living or work space and know when I enter what is amiss, where it acts in the body for me and for the client, determine the source and remediation.



Michael J. Schwaebe, P.E., BBEC

215 Andrew, Encinitas, CA 92024

September 2, 2013

Organizations; Environmental Working Group Reply Comments, Mar. 18, 2015

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of)	
)	
Reassessment of Federal Communications)	ET Docket No. 13-84
Commission Radiofrequency Exposure)	
Limits and Policies)	
)	
Proposed Changes in the Commission’s Rules)	ET Docket No. 03-137
Regarding Human Exposure to Radiofrequency)	
Electromagnetic Fields)	

REPLY COMMENTS OF ENVIRONMENTAL WORKING GROUP

Environmental Working Group (“EWG”) submits these reply comments in response to the Federal Communications Commission’s (“FCC”) First Report And Order, Further Notice of Proposed Rule Making, and Notice Of Inquiry (“NOI”) in the above-captioned dockets. In its initial comments, EWG urged the Federal Communications Commission to strengthen its cell phone radiation standards so that they will adequately protect both children and adults, reflect actual current use patterns and provide meaningful consumer disclosure without preempting states from requiring additional disclosure. EWG also urged the FCC to not weaken its existing

standards by altering its testing guidelines to adopt average radiation exposure testing over a larger volume of tissue.

Some commenters in these proceedings have made a number of false assertions surrounding the safety factor in current RF standards, the state of the science surrounding potential harm from cell phone radiation, the adequacy of current federal and international standards to protect children and adults, the trends in RF exposure among Americans, the consensus of the international community on the need for precautionary action, and the pitfalls of increasing consumer education and transparency measures, among other issues. EWG submits the following comments to clarify the record and urges the FCC to dismiss these mischaracterizations.

I. THE FCC SHOULD DISMISS ASSERTIONS THAT CURRENT FEDERAL AND INTERNATIONAL STANDARDS FOR CELL PHONE RADIATION ARE OVERLY PROTECTIVE. IN REALITY, THESE STANDARDS ARE NOT SUFFICIENTLY PROTECTIVE OF CHILDREN OR ADULTS.

A. The FCC's standard does not include a 50-fold safety factor for exposure to the head, the organ of greatest concern for cell phone radiation.

Several groups put forth in their comments to the FCC that the 50-fold safety factor used to set federal standards makes those standards conservative. What is important to note, however, is that there is only a 50-fold safety factor employed for whole body SAR standards of 0.08 W/kg. The maximum SAR standard for the head, in contrast, is 1.6W/kg, giving a “safety factor” of only 2.5, which could be considered negligible. For hands, wrists, and feet there is no safety factor. This is a critical point given that one of the key organs of greatest concern when it comes to potential impacts of cell phone radiation.

To make matters worse, an assessment done by EPA in 1984 concluded that biological effects occur at SAR levels of 1 W/kg, 4 times lower than the level chosen by IEEE (U.S. EPA 1984). Therefore the point of departure of 4W/kg used by IEEE and adopted by FCC is likely an overestimate. Based on EPA's proposed point of departure of 1W/kg, and the unusually small safety factor applied by FCC, the calculated maximum SAR values are much higher than what would be assumed to be health protective. At best, FCC standards give adults a slim margin of safety over emission levels that harm animals. For children, the margin is even smaller.

B. Current standards do not account for children's higher RF exposures and greater health risks.

As detailed extensively in EWG's original filing, research shows that children may be more vulnerable to RF-EMF, yet limits on specific absorption rates are the same for children and adults and do not account for children's higher exposures and greater health risks. The size and tissue properties of a child's head increase radiation absorption, and several scientific studies have shown that the head and brain of a child absorb significantly more radiation than those of an adult (de Salles 2006; Gandhi 1996; Kang 2002; Martinez-Burdalo 2004; Peyman 2009; Wang 2003; Wiart 2008).

When cell phones are used by children, the average RF energy deposition is 2 times higher in certain regions of the brain and up to ten times higher in the bone marrow of the skull, compared to energy deposition in adult brains (IARC 2010; Christ 2010).

Comments submitted by the Mobile Manufacturers Forum state the phantom model is conservative. But research studies have indicated that the phantom model based on an adult head may grossly underestimate the RF-EMF exposure on a 1 gram level with respect to children, an issue of increasing concern. In a study published by France Telecom in 2008, peripheral brain tissue showed a maximum SAR two times higher than measured in adults due to lower

thicknesses of the pinna, skin and skull (Wuart 2008). All these data, taken together, suggest that when a child uses a cell phone that complies with the FCC standards, he or she could easily absorb an amount of radiation over the maximum allowed radiation limits defined by the federal guidelines.

C. Only 10 percent of EPA risk assessments employ uncertainty factors as low as 50.

Even it were true that the FCC's standards employed a 50-fold safety factor for adults and children, it is important to note that in government risk-assessments of environmental toxicants, a 50-fold safety factor is actually quite *low*. The Environmental Protection Agency, for example, typically uses safety factors in the 100s or 1000s range, sometimes as much as even 10,000. An EWG review of the 457 risk assessments that EPA has completed for potentially toxic chemicals finds that only 46 of them, or 10% employ safety factors of 50 or below (U.S. EPA 2013).

D. Harmonization with international standards would weaken current FCC standards.

Harmonization with international standards may seem would weaken current FCC standards because it would increase the average mass used in calculating SAR, and likely miss "hot spots" of radiation. As the mass used in the SAR value is increased the variations in exposure are averaged resulting in a corresponding decrease in the SAR value (Beard 2006). In studies using a patch antenna at 1850 MHz the 1 gram SAR values was calculated to be over 50% higher than the 10 gram SAR value (de Salles 2006).

Comments submitted by the Mobile Manufacturers Forum suggest that a 10 gram averaging mass is equivalent to the weight of the eye, one of the most sensitive organs, which when heated can cause cataracts, and therefore a 10 gram mass is more biologically based. This argument, however, is entirely misguided and grossly underestimates the size scale of localized

biological changes that may lead to long-term health consequences. The formation of cataract occurs in the lens portion of the eye (a very small part of the total eye) and occurs through the denaturing of proteins that then aggregate together and cause clouding of the lens by modifying the lens refractive index (Horwitz 2003). With the weight of these lens proteins in the attogram range, changing the averaging mass used in the SAR standard to a more biologically based number should result in a large reduction of the mass used to calculate SAR not an increase.

With biological effects occurring on the protein and single molecule level it is a concern that localized “hot spots” could also impact brain tissue (Blackwell 2009). Moreover, research has shown that using the SAR 1g calculation can be a better predictor of peak temperature increases and the location of the heating compared to the 10g model (Bakker 2011). Changing the current 1 gram mass used in calculating the SAR to a larger 10 gram mass would significantly underestimate exposure and discount the effects of localized biological damage.

II. THE FCC SHOULD REJECT CLAIMS THAT THERE IS NO EVIDENCE POINTING TO POTENTIAL HARM FROM EXPOSURE TO CELL PHONE RADIATION. THERE ARE NOW NUMEROUS STUDIES SUGGESTING THAT RF EXPOSURE AT CURRENT EXPOSURE LEVELS COULD HAVE NEGATIVE HEALTH EFFECTS, RASING QUESTIONS ABOUT THE ADEQUACY OF CURRENT STANDARDS.

A. Numerous human and animal studies now point to potential health concerns.

Some commenters contend that there is no convincing evidence of harm from cell phone radiation, while there is actually a growing body of research that points toward the opposite conclusion. In human studies, cell phone radiation has been linked to effects on male reproduction such as effects on sperm count and motility (Agarwal 2008; Agarwal 2009; De Iuliis 2009; Davoudi 2002; Gutschi 2011; Falzone 2011; Fejes 2005; Kilgallon 2005; Wdowiak 2007). Other reports suggest exposure to RF-EMF could be linked to obesity and behavioral

problems (Divan 2008; Divan 2012; Li 2012). And the International Agency for Research on Cancer (IARC) has classified radiofrequency electromagnetic fields as “possibly carcinogenic to humans (Group 2B)” based on increased risk for brain glioma observed during the large epidemiological INTERPHONE study (IARC, 2013).

There is a plethora of animal data suggesting exposure to RF may be harmful. Among the reported health impacts are effects on the developing fetus, neurological effects, reproductive effects, increased blood brain barrier permeability, hyperactivity, and immune system effects (Aldad 2012, Gul 2009, Nittby 2008, Odaci 2008, Sonmez 2010; Szmigielski 2013). Laboratory studies on the effects of cell phone radiation on rats, rabbits and other animals have also demonstrated a variety of effects on reproductive health (Al-Damegh 2011; Kesari 2011a; Kesari 2011b; Kesari 2012; Mailankot 2009; Salama 2009; Yan 2007). Some of these findings have been reported in humans, as noted above.

The CTIA states in its comments to the FCC that the INTERPHONE study found no increased risk for glioma. This is inaccurate. A 2011 article published in The Lancet that summarizes the results of the INTERPHONE study states that for the highest exposure (>1640 hours of use) “the OR for glioma was 1.40 (95% CI 1.03–1.89). There was suggestion of an increased risk for ipsilateral exposure (on the same side of the head as the tumour) and for tumours in the temporal lobe, where RF exposure is highest.” Therefore in some cases increased risk was reported (Baan 2011). In fact there are a variety of studies that have shown an increased risk of developing two types of brain tumors (glioma and acoustic neuroma) on the ipsilateral side (the side of the brain on which the cell phone is primarily held) among people who used a cell phone for longer than 10 years (Benson 2013; Hardell 2006b; Hardell, 2009; Hardell 2013; Lahkola 2007; Levis 2011; Schuz 2006).

Three recent studies also reported increased risk of salivary gland (parotid) tumors among cell phone users. Parotid gland malignancies involve tumors occurring in the largest salivary gland (parotid gland) located above the jaw and in front of the ear. Some results suggest these cancers were also associated with the duration of cell phone use (Duan, 2011; Lonn 2006; Sadetzki 2008). For example, a Chinese retrospective study of 136 patients with epithelial parotid gland malignancy found that long term and heavy use of cell phones was positively correlated with these tumors (Duan 2011).

It is important to note that the latency time for developing brain cancer is typically between 10-15 years (ACS, 2012). As we point out in the original comments filed, current studies may not be reflective of future trends in disease, particularly in those who began using cell phones as children. It seems likely that studies conducted in future years may find more consistent and higher cancer risks (Ahlbom 2004; Ahlbom 2009; Inskip 2010; Krewski 2001; Krewski 2007; Kundi 2009; Kundi 2004). Accordingly, a 2011 meta-analysis on head tumor risk and cell phone use found a significant increase in risk of ipsilateral brain gliomas and acoustic neuromas in people who had used cell phones for at least 10 years (Levis 2011).

In summary, emerging scientific data demonstrates that RF-EMF emitted from cell phones has the potential to adversely affect the health of people. This makes the case for setting a health-protective SAR limit and providing more information to consumers who wish to make informed choices.

B. There are several potential biological mechanisms for harm from RF energy.

In light of the growing scientific evidence showing that RF-EMF can exert negative effects on animals and may be associated with health effects in people, the question shifts to the mechanism by which RF-EMF may cause harm. Several suggestions have been made. Research

shows that electromagnetic radiation may disrupt the blood brain barrier (Ding 2010; reviewed in Nittby 2008; Söderqvist 2009a; Söderqvist 2009b). A number of studies examined the potential for genotoxicity (harm to genetic material that can lead to mutations and cancer) of electromagnetic fields (BioInitiative 2007; Phillips 2009). While the evidence is not yet conclusive, a meta-analysis of research published between 1990-2011 reports a significant association between DNA damage and radiofrequency fields in half of the results reported for 6 different indicators of genotoxicity in human cell lines (Vijayalaxmi 2012).

Scientists have also reported that cell phone radiation increases reactive oxygen species (ROS) inside the cell (Güler 2012; Irmak 2002; Kesari 2011a; Kesari 2012; Lu 2012; Zmyslony 2004). In turn, higher ROS levels trigger intracellular signaling cascades that can interrupt the smooth functioning of the cell or lead to cell death. Cell phone radiation-induced ROS may well be a causative agent that induces DNA damage, which is a precursor to cancer (Phillips 2009) and a potential mechanism of toxicity to sperm cells (Agarwal 2009; De Iuliis 2009; reviewed in Desai 2009; Kesari 2012; reviewed in Kesari 2013).

C. If researchers are finding effects at current levels of exposure to cell phone radiation, this raises serious questions as to whether FCC and international standards are truly conservative.

Some commenters have asserted that the current FCC standards and international standards are very conservative, and therefore there should be no hesitation to harmonize the standards. However if the associations between male reproductive effects, cancer, and cell phone radiation are real, these effects are occurring at the exposure levels allowed in current standard. Recent studies on men exposed to cell phone radiation at current levels show an association between reduced sperm count and motility and phone use (Agarwal 2008; Agarwal 2009; De Iuliis 2009; Davoudi 2002; Gutschi 2011; Falzone 2011; Fejes 2005; Kilgallon 2005; Wdowiak

2007). It is also concerning that animal studies have shown adverse effects at exposure levels experienced by humans. For example, fetal exposure to 800-1900 Mhz-rated cell phones produced neurodevelopmental and behavior effects in mice (Aldad 2012).

III. THE FCC SHOULD DISMISS REQUESTS FOR THE TESTING REGIME TO REMAIN UNCHANGED. THE FCC MUST MODIFY ITS TESTING GUIDELINES TO INCLUDE “ZERO SPACING” TO ACCOUNT FOR THE SIMPLE FACT THAT MANY CONSUMERS CARRY THEIR PHONES DIRECTLY AGAINST THEIR BODIES.

A. Consumers sometimes carry cell phones directly against their bodies; the FCC’s standards must be updated to reflect this simple fact.

In its Notice of Inquiry, the FCC acknowledges that there are “circumstances where test configurations may not reflect actual use” because current federal guidelines allow cell phone companies to use a spacer of up to 2.5 centimeters in “body-worn testing configurations.” These guidelines appear to stem from an FCC assumption in 1996 that consumers would be carrying their phones in holsters, rather than directly against the body.

Whatever the reason for the agency’s earlier decision, it is clear that the FCC must now update its testing guidelines to reflect the reality that many people commonly carry their phones directly against the body, often putting them phones in a pocket or and placing them on the lap – sometimes even placing them in their bras. Several commenters have asserted that a zero-spacing requirement would not mimic real usage, but this is simply untrue.

Notably, a 2012 Government Accountability Office (GAO) report concluded that consumers who hold a phone directly against the body could receive “*RF energy exposure higher than the FCC limit*” and recommended that the FCC “[r]eassess whether mobile phone testing requirements result in the identification of maximum RF energy exposure in likely usage

configurations, particularly when mobile phones are held against the body, and update testing requirements as appropriate” (GAO 212).

EWG strongly agrees with this recommendation. Given that holsters and belt clips are not commonly used today, it makes no logical sense to test RF exposure compliance of wireless devices at *any* distance from the body if the agency aims to simulate real-world usage. This is particularly important since at least some testing has indicated that RF exposure from an iPhone 4 would exceed FCC guidelines by a factor of three if tested right next to the body (Pong 2012). The difference is between allowing a 2.5 cm gap and zero spacing is not trivial.

Some commenters have suggested that it would be difficult for phones currently on the market to comply with zero-spacing proximity requirements. This should not be a reason for the FCC to keep the current testing regime. Manufacturers are constantly innovating and will be able to design for changes in the proximity requirement.

B. The industry’s SAR Tick program will not solve the inherent problems with FCC testing regimen.

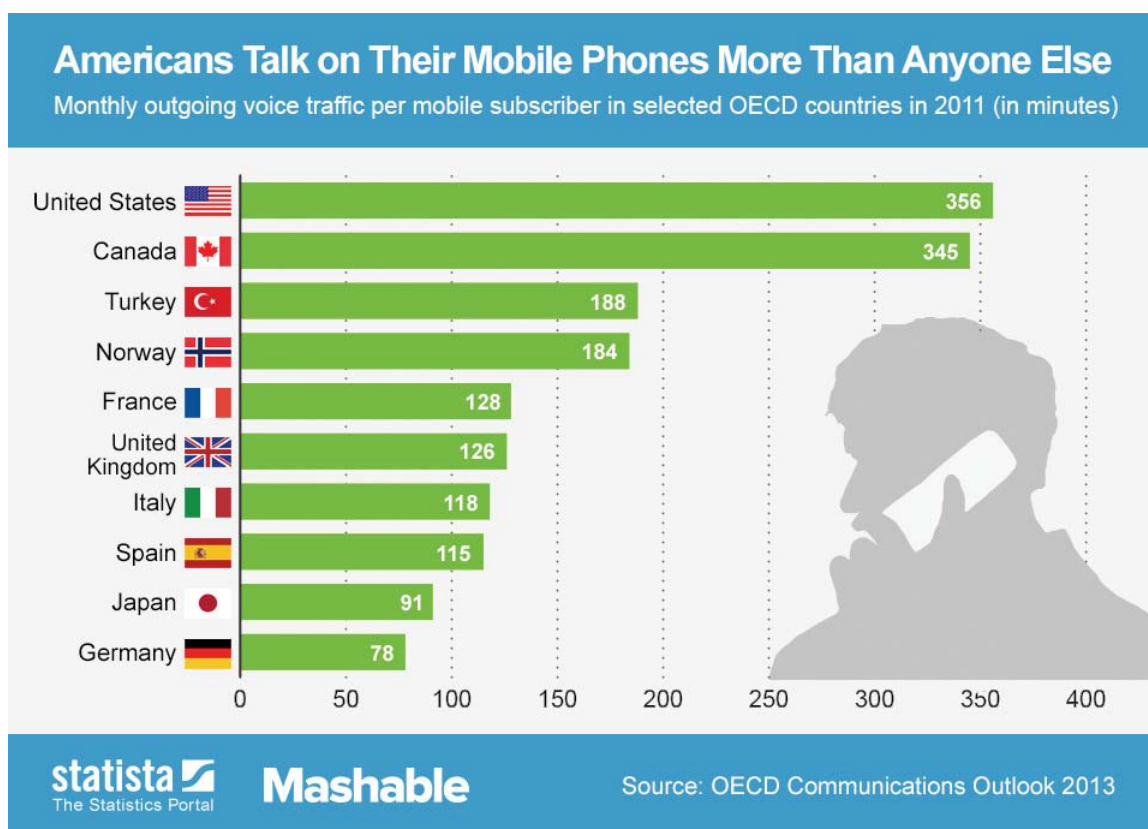
Some commenters have suggested that the cell phone industry’s new “SAR Tick” program will address the concerns around FCC’s flawed proximity testing because consumers will be better educated about how to properly use their phones so as not to exceed SAR limits. Yet the simple fact is that few consumers ever look at their cell phone manuals, and more importantly, consumers should be given real protection based on how they *actually* use their phones – not how the FCC falsely assumes people would use their phones (i.e. in a holster).

IV. AMERICAN’S EXPOSURE TO CELL PHONE RADIATION IS ON THE RISE, AND LIKELY TO INCREASE FURTHER WITH THE TRANSITION TO LTE NETWORKS.

A. The average number of minutes Americans spend talking on their cell phones has increased by 6.5 times since 1996; Americans talk on their cell phones more than people

in any other country.

According to data published in 2013 by the Organization for Economic Co-operation and Development (OECD), the number of minutes Americans have spent talking on their cell phones has increased from 651 minutes per year in 1996, to 1,929 minutes in 1999, to 3,369 minutes in 2004 to 4,273 minutes in 2013 (OECD 2013). In other words, the amount of time Americans have spent talking on their cell phones has increased by a factor of 6.5 since 1996. It is also worth noting that Americans spend more talking on their phones than in other countries as the graph below demonstrates (Statista 2013).



A. Recent studies suggest that average radiation exposure will increase with the transition to LTE networks.

Some commenters have correctly stated that there was a major reduction in consumer

radiation exposure in the shift from 2G to 3G WCDMA transmission technologies. While 2G transmitted at 20-70 percent maximum SAR in average usage, 3G phones generally transmitted at levels below 1 percent of maximum SAR (Gati 2009; Vrijheid 2009).

What was not mentioned, however, is that experts have raised concerns that LTE transmission technology and its multiple-in/multiple-out antenna designs have transmission characteristics similar to 2G technology and that exposure will be a larger fraction of maximum SAR than 3G technology (Shi 2012; Anderson 2011). One recent study, for example, has shown that, for a given power output to the antenna, the newer 4th generation LTE antenna design produces a SAR value that is 2-to-60 times greater than the 2G and 3G designs (Shi 2012).

V. THE NEW “SAR TICK” INITIATIVE AND OTHER EFFORTS BY THE FCC AND THE CELL PHONE INDUSTRY DOES NOT COME CLOSE TO PROVIDING SUFFICIENT REAL-WORLD INFORMATION FOR CONSUMERS ABOUT CELL PHONE RADIATION.

A. The FCC and industry acknowledges the inherent problems with using SAR as a proxy for exposure. Therefore, any education efforts that focus on SAR values will be insufficient to satisfy consumers’ right-to-know.

On its website the FCC describes in detail why the maximum Specific Absorption Rate (SAR) – currently the *only* RF exposure metric tested by the FCC and made available to consumers – is not a good predictor of actual exposure to RF energy from cell phones (FCC 2013). The FCC notes, for instance, that “a single SAR value does not provide sufficient information about the amount of RF exposure under typical usage conditions to reliably compare individual cell phone models” (FCC 2013). Therefore, doing a slightly better job at disclosing SAR values to consumers will accomplish little.

B. RF exposure varies by service provider, transmission technology, frequency bands, location and proximity to cell phone towers.

Recent studies have indicated that a consumer's choice of wireless network, with its associated frequency bands and transmission encoding, may be a more important factor in cell phone RF exposure than the cell phone model. The technology used in transmitting and encoding cell phone signals has been changing every few years: from GSM to CDMA to WCDMA and most recently to LTE. The changing antenna design, transmission frequency and encoding have large effects on average RF exposure levels (Shi 2012, Kelsh 2011).

As described above, for a given power output to the antenna, the newer 4th generation LTE antenna design produces a SAR value that is 2-to-60 times greater than the 2G and 3G designs (Shi 2012). Research has shown that there was a major reduction in consumer radiation exposure in the shift from 2G to 3G WCDMA transmission technologies. While 2G transmitted at 20-70 percent maximum SAR in average usage, 3G phones generally transmitted at levels below 1 percent of maximum SAR (Gati 2009; Vrijheid 2009). As the technology has evolved, concerns have been raised that LTE transmission technology with multiple-in/multiple-out antenna designs have transmission characteristics similar to 2G technology and that exposure will be a larger fraction of maximum SAR than 3G technology (Shi 2012; Anderson 2011).

Although studies have found marked differences in average SAR levels among cell phone networks, the FCC currently provides consumers with absolutely no information to assist them in choosing a cell phone provider that will expose them to lower cell phone RF energy. This not only inhibits consumer's ability to make informed purchasing decisions, it also deprives the public of its right to know. Because it is now clear that cell phone network technologies affect RF exposure as much as the phone design itself, the FCC-mandated exposure metrics should incorporate both parameters in an expected in-use SAR rating.

V. THE FCC SHOULD DISMISS ASSERTIONS THAT ENCOURAGING METHODS

FOR LIMITING RF EXPOSURE AND PROVIDING ADDITIONAL CONSUMER DISCLOSURE WILL CAUSE CONFUSION, ALARM, AND/OR DISCOURAGE THE USE OF PORTABLE DEVICES.

CTIA suggests that providing more information to consumers about cell phone radiation standards and ways to reduce exposure would create unnecessary fear, confusion, and discourage the use of mobile devices. This is absurd. Given their incredible usefulness, it is quite clear that consumers will continue to buy and use mobile devices. Consumers receive many types of warnings and advice on a vast array of consumer products that remain widely used nonetheless; there is nothing to suggest that cell phones would follow a different trend.

CTIA suggests that setting a conservative standard could “have the perverse effect of increasing public anxiety,” yet it is more likely that the setting of health protective RF standards will have the opposite effect and ease public anxiety. Consumers will view this as a positive response to a potential public health issue, and see that the FCC is taking the health of children into account. The public wants regulations that will protect them. If the government errs on the side of caution, the public will have the peace of mind to know that good faith efforts are being made to protect from potential adverse health effects. If the government errs of the side of less protection, this decreases trust in regulatory agencies and does not ease anxieties about potential harm.

VI. RECENT INTERNATIONAL ACTIONS SHOW GROWING CONCERN OVER POTENTIAL EFFECTS OF CELL PHONE RADIATION, PARTICULARLY FOR CHILDREN.

Several parties stated in their comments to the FCC that there is international consensus that cell phone radiation poses no health concerns and that the current standards are overly conservative. Recent action taken by countries around the world, however, demonstrate that this

assertion is false. In reality, there are a growing number of countries who are taking precautionary action as well as increasing consumer access to information.

France

In 2010, The French government banned cell phones directed at children under 6, cell phone advertising to youth under 14, and restricted use of mobile phones in school by children during lesson times (Article L511-5, Code of Education). All phones sold in France must come with a headset, and SAR values must be displayed at the point of purchase whether in stores or online. The French government, through its National Institute for Prevention and Health Education operates a cell phone safety educational program (France NIPHE 2013).

Belgium

In October of 2013, Belgium adopted new cell phone regulations that bar mobile phone models designed for, and marketed to children ages 7 and younger. Under Belgium's new rules, slated to take effect next March, cell phone retailers will be also required to disclose phones' SAR values at the point of sale (Belgium FPS 2013).

India

In 2012, the Indian Department of Telecommunications ruled that all new cell phone models manufactured in or imported into India shall "comply with the SAR values of 1.6 W/kg averaged over 1 gram of human tissue," as of September 1, 2013 and existing models that are compliant with the European standards of 2.0 W/kg averaged over 10 gram of human tissue are only be manufactured in or imported into India until August 31, 2013 (India DOT 2012). The Indian government also requires that SAR values be displayed at the point of sale.

European Union

Member states of the Council of Europe adopted a resolution in 2011 recommending among other things, to “take all reasonable measures to reduce exposure to electromagnetic fields, especially to radio frequencies from mobile phones, and particularly the exposure to children and young people who seem to be most at risk from head tumours” (Council of Europe 2011).

In 2008, the European Parliament approved a resolution calling for stricter exposure limits for cell phones and other wireless devices. “[The Parliament notes] that the limits on exposure to electromagnetic fields which have been set for the general public are obsolete. They do not take account of developments in information and communication technologies or vulnerable groups, such as pregnant women, newborn babies and children. The plenary therefore calls on the Council... to take into account the Member States' best practices and thus to set stricter exposure limits for all equipment which emits electromagnetic waves in the frequencies between 0.1 MHz and 300 GHz” (European Parliament 2008b). Article 22 of the 2008 Resolution highlights the importance of the precautionary approach supported by the European Environment Agency and promotes adoption of the stricter emission standards such as those developed in Belgium, Italy and Austria (European Parliament 2008a).

The European Parliament resolution on “Health concerns associated with electromagnetic fields” (INI/2008/2211), adopted by 559 votes to 22 on 2 April 2009, called for bringing greater transparency to the radiofrequency radiation exposure and for adoption of precautionary measures. The resolution stated: “Wireless technology (cell phones, Wi-Fi/WiMAX, Bluetooth, DECT landline telephones) emits EMFs that may have adverse effects on human health. Most European citizens, especially young people aged from 10 to 20, use a cell phone, while there are

continuing uncertainties about the possible health risks, particularly to young people whose brains are still developing” (European Parliament 2009). The resolution also called for a “wide-ranging awareness campaign should be initiated to familiarize young Europeans with good cell phone techniques, such as the use of hands-free kits, keeping calls short, switching off phones when not in use (such as when in classes) and using phones in areas that have good reception.”

Switzerland

The Swiss Federal Office of Public Health states on its website that although the one study looking at mobile phone use and brain tumors in children did not find a link, there is “uncertainty over the extent to which children's heads absorb radiation and about the effect on the development of nerve tissue and the brain. These uncertainties and the fact that mobile phone usage is beginning at an increasingly young age justify the use of low-emission mobile phones, especially in children and adolescents” (Swiss FOPH 2013). Similar findings are made for impacts of cell phone radiation on sperm, stating that: “As a precaution, mobile phones should not be positioned close to the genitals when making calls with hands-free devices.” In general, the Office advises consumers to minimize their exposure by using a hand-free system, keeping calls short, buying phones with low SAR values and using phones when the signal quality is good.

Germany

The German Federal Office for Radiation Protection (Bundesamt für Strahlenschutz, BfS) has created a “Blue Angel” eco-seal for low-emission cell phones, which are defined as those phones have emissions at or below 0.6 W/kg (BfS 2013a). BfS recommends a precautionary approach to cell phone use, particularly for children, such as using a landline;

making shorter cell phone calls; avoiding using a cell phone when the connection is weak; and, as much as possible, using a headset and substituting text messaging instead of making a call (BfS 2013b).

Israel

In 2008, Israel's Ministry of Health stated that although it is still not clear whether cell-phone use is connected to an increased risk of developing cancerous growths, current research already supports a policy of "preventive caution" (Israel Ministry of Health 2008). The Ministry published a set of guidelines that called for limiting children's use of cell phones, avoiding cellular communication in enclosed places such as elevators and trains, and using wired, not wireless, earpieces (Azoulay 2008). The Ministry developed these guidelines following a national study that detected an association between cell phone use and the risk for developing tumors of the salivary gland (Sadetzki 2008; Traubmann 2007).

Canada

Canada's federal public health department, Health Canada, states on its website: "Health Canada reminds cell phone users that they can take practical measures to reduce their RF exposure by: limiting the length of cell phone calls, using "hands-free" devices, replacing cell phone calls with text messages." "Health Canada also encourages parents to take these measures to reduce their children's RF exposure from cell phones since children are typically more sensitive to a variety of environmental agents" (Health Canada 2013).

United Kingdom

The UK Department of Health supports "a precautionary approach" to the use of cell phones until more research findings become available. In 2000, the UK convened an expert panel

to examine the potential health effects of cell phone radiation, and the results were published in what became known as the “Stewart Report.” As described on Public Health England’s website:

“This expert group concluded that there was no clear scientific evidence of harm to health from exposure to mobile phone signals. However, the expert group was concerned about the widespread adoption of a new technology involving exposure from radio waves to people's heads, including those of children, at levels that are significant fractions of international guidelines. This, and some uncertainties in biological evidence, led the expert group to advise some precaution, particularly in the use of mobile phones by children. This advice was accepted by the Department of Health and leaflets and other information were provided for the public in 2000 and 2004. The basic advice from the Stewart Report continues to be the advice of the Health Protection Agency. The benefits of mobile telecommunications are widely recognised but, given the uncertainties in the science, some precaution is warranted particularly regarding the use of handsets held against the head. This is especially relevant to the use of handsets by children and the Agency recommends that excessive use by children should be discouraged” (Public Health England 2013).

Finland

In January 2009, the Finnish government stated that children's cell phone use should be restricted, for example, by sending text messages instead of talking, making shorter calls, using a hands-free device, and avoiding the use of cell phones when connection is weak. According to the Finnish report, “although research to date, has not demonstrated health effects from cell phone’s radiation, precaution is recommended for children as all of the effects are not known” (STUK (Finnish Radiation and Nuclear Safety Authority) 2009).

The Finnish Radiation and Nuclear Safety Authority's website states that children have a "special status as mobile phone users, among others, because brains continue to develop even up to 20 years of age. It should also be taken into account that children will have much more time to use mobile phones than adults today who started their regular mobile phone use only about ten years ago. The risk of long-term use of mobile phones cannot however be assessed with certainty until mobiles phones have been in use for several decades. On the grounds of the above-mentioned facts, STUK states that it is reasonable to restrict children's use of mobile phones..." (STUK (Finnish Radiation and Nuclear Safety Authority) 2013).

Russia

Listed in the Sanitary Rules of the Russian Ministry of Health (SanPiN 2.1.8/2.2.4.1190-03 point 6.9), are cautions against persons under 18 using mobile phones. The National Committee for Non-Ionizing Radiation Protection issued guidance in 2008 on the subject of children and mobile phones based on the concern and cite potential risk of illness from cell phone use to children under 16, pregnant women, epileptics, and people with memory loss, sleep disorders and neurological diseases (RNCNIRP 2008). Both the Russian Ministry of Health and the members of Committees of health protection in the Russian Parliament support the viewpoints of the RNCNIRP.

VII. TAKING PRECAUTIONARY MEASURES IS NOT UNSCIENTIFIC.

EWG strongly disagrees with CTIA's suggestion that "the fundamental nature of the "precautionary principle" means that those decisions are untethered from the existing body of scientific research." It is unnecessary and onerous to require absolute certainty before implementing standards and regulations intended to protect public health. If the scientific

evidence is sufficiently suggestive that there is a potential risk to public health, action should be taken to prevent that threat. This is the basis of the precautionary principle. Decisions under this paradigm are made with the recognition that there are always unknowns in science.

The precautionary principle is highly regarded and used by scientists and government agencies worldwide. In the European Union, the precautionary principle is accepted as an important aspect of environmental policy (Europa 2011). It is embedded in a number of environmental and public health policies in countries such as Denmark, Germany, United Kingdom and Sweden (Lokke and Christensen, 2008). Denmark, for example, utilized the precautionary principle to call for the prohibition of phthalates in children's toys (1997), to recommend avoiding triclosan in consumer goods (2001) and to recommend that specific sunscreen ingredients (4-MBC) should not be used on children under 12 years (2001) (Lokke and Christensen 2008).

The precautionary principle is also well utilized in the United States. The San Francisco Department of the Environment highlights the principle as “the first guiding principle [to reduce the impact of harmful chemicals on San Franciscans and [the] environment]” (San Francisco Department of the Environment 2013). The American Public Health Association, “recognizing that public health decision must often be made in the absence of scientific certainty, or in the absence of perfect information” explicitly endorses the precautionary principle “as a cornerstone of preventative and public health practice” (APHA 2000).

According to Kriebel (2001), one of the primary tenets of the precautionary principle is to take “preventative action in the face of uncertainty”. In this vein, health agencies in six nations – Switzerland, Germany, Israel, France, United Kingdom and Finland – have recommended reducing children's exposure to cell phone radiation in light of growing evidence of adverse

health impacts.

The CTIA also suggested that “further precautionary measures” would be arbitrary and capricious. However, there is new scientific evidence that children may be at an increased health risk, in addition to new data in animals and people suggesting what those health risks may be. Therefore further precautionary measures taken by FCC would neither be arbitrary or capricious. Not only are precautionary actions perfectly reasonable, in light of the new science they necessary to protect public health.

The precautionary principle is an important tool to help protect the public from environmental risks and remains a strong basis to call for the FCC to strengthen their cell phone radiation standards so that they will adequately protect both children and adults. Given the unknowns regarding the adverse effects of cell phone radiation and the widespread nature of exposure, the FCC is exercising remarkably little precaution in this matter.

VIII. CONCLUSION

Faced with an exploding cell phone market, growing evidence of potential harm from cell phone radiation and uncertainties that will likely remain unresolved for decades to come, it would be a mistake for the FCC to essentially weaken its standards by “harmonizing” them with international standards. Rather, this is the time to strengthen federal standards, make them more reflective of how consumers actually use their phones, provide consumers with useful, real-world information they can use to inform their choice of phones and networks, and educate consumers about other ways to reduce their exposures.

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Nina Beety Comments, Nov. 18, 2012

FCC 13-39

**Before the
Federal Communications Commission
Washington, D.C. 20554**

In the Matter of)	
)	
Reassessment of Federal Communications)	ET Docket No.
13-84		
Commission Radiofrequency Exposure Limits and)	
Policies)	
)	
Proposed Changes in the Commission's Rules)	ET Docket No. 03-137
Regarding Human Exposure to Radiofrequency)	
Electromagnetic Fields)	
)	

To: Office of the Secretary
Federal Communications Commission
Washington, DC 20554

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November 18, 2013

In order to protect human and environmental health, the FCC must take these actions as a result of its review of RF guidelines:

- Establishment of FCC standards, instead of guidelines
- Strict enforcement of those standards
- Biologically based standards
starting at the “precautionary action level of 0.0003 microW/cm² to 0.0006 microW/cm²” suggested in the 2012 Bioinitiative Report update or the Austrian Medical Association’s recommendations for “normal” exposures no higher than .0001 microW/cm².
- Standards that protect the most vulnerable in society and pertain to men, women, children, babies, pregnant women, the elderly, the infirm, those who are electrohypersensitive (EHS), those who have compromised immune systems, those with metal implants, those with medical implants, healthcare facilities with health monitoring equipment.
- Standards updated every two years at a minimum
- No exemptions; standards that protect from all forms of RF, including cellular communications, commercial telecommunications (AM/FM, TV, UHF, VHF), satellites, military uses, hobby/HAM radio, emergency communications
- Standards that reflect weight of evidence and the precautionary principle, and respect all life.

Why are the present “guidelines” inadequate?

- Limitations of present “guidelines”
- Extensive research showing harm below present “guidelines”

Norbert Hankin, U.S. Environmental Protection Agency (EPA), 2002:

“The FCC’s current exposure guidelines, as well as those of the Institute of Electrical and Electronics Engineers (IEEE) and the International Commission on Non-ionizing Radiation Protection (ICNIRP), are thermally based, and do not apply to chronic, nonthermal exposure situations. They are believed to protect against injury that . . . result(s) in tissue heating or electric shock and burn. . . The FCC’s exposure guideline is considered protective of effects arising from a thermal mechanism . . . the generalization by many that the guidelines protect human beings from harm by any and all mechanisms is not justified.”

http://www.emrpolicy.org/litigation/case_law/docs/noi_epa_response.pdf

Michael Bevington, 2008

...a standard textbook on bioelectromagnetics (2007 edition) states that ‘the biophysical lore prevailing until the late 1980s and lingering to this day’ was that external EFs had no effect on human tissue unless they could trigger an excitable membrane, such as in the heart by a pacemaker, produce heating (thermal), or move an ion along a field gradient. ‘However, the position had to be changed as the evidence for weak (nonthermal) EMF bioeffects became overwhelming’.(3)

(3) Barnes, Frank S., and Greenebaum, Ben (edd.), Handbook of Biological Effects of Electromagnetic Fields: Biological and Medical Aspects of Electrical

Fields, CRC Press, 3rd ed. based on updated literature reviews to mid 2005, 2007), p.377.

Attitudes to the health dangers of non-thermal EMFs, 2008

http://www.powerwatch.org.uk/news/20080117_bevington_emfs.pdf

Santa Cruz County Health Department, January 13, 2012

"There are no current, relevant public safety standards for pulsed RF involving chronic exposure of the public, nor of sensitive populations, nor of people with metal and medical implants that can be affected by localized heating and by electromagnetic interference..."

"...FCC guidelines are irrelevant and cannot be used for any claims of [wireless] SmartMeter safety unless heat damage is involved."

Health Risks Associated with Smart Meters,
Health Officer Dr. Poki Stewart Namkung MD, MPH;
Attachment B, B1, B2

http://sccounty01.co.santa-cruz.ca.us/bds/Govstream/BDSvData/non_legacy/agendas/2012/20120124/PDF/041.pdf

Government of India, Ministry of Environment and Forests (2011):

The adverse effects of electromagnetic radiation from mobile phones and communication towers on health of human beings are well documented today."

Report on Possible Impacts of Communication Towers on Wildlife
including Birds and Bees, October 2011

http://moef.nic.in/downloads/public-information/final_mobile_towers_report.pdf

India has taken a series of actions lately including making their exposure limits stricter.

The Swiss telecom company Swisscom (2004):

"The influence of electrosmog on the human body is a known problem."

Reduction of Electrosmog in Wireless Local Networks,
Patent Application by Swisscom AG, Sept. 2, 2004,
cited in The Swiss Experience, Magda Havas, p. 3

http://www.safeschool.ca/uploads/WiFi_Swisscom_Patent.pdf

ECOLOG Institute report for T-Mobile, 2000:

This review of over 220 peer-reviewed and published papers found strong indications for the cancer-initiating and cancer-promoting effects of high frequency electromagnetic fields used by mobile telephone technology. Experiments on cell cultures at power flux densities much lower than the guidelines, yielded strong indications for genotoxic effects of these fields, like single and double stranded DNA breaks and damage to chromosomes. The findings that high frequency electromagnetic fields influence cell transformation, cell growth promotion and cell communication also point on a carcinogenic potential of the fields used for mobile telephony. The study also found teratogenic effects (birth deformities) and loss of fertility in animal studies. Moreover, disruptions of other cellular processes, like the

synthesis of proteins and the control of cell functions by enzymes, have been demonstrated.

Numerous experiments on humans as well as on animals proved effects on the central nervous system, which reach from neuro-chemical effects to modifications of the brain potentials and impairments of certain brain functions. Loss of memory and cognitive function, for instance, have been demonstrated by animal experiments. From experiments with volunteers, who were exposed to the fields of mobile telephones, there is clear evidence for influences on certain cognitive functions. Possible risks for the brain also arise from an increased permeability of the blood-brain barrier to potentially harmful substances, observed in several experiments on animals exposed to mobile telephone fields.

The ECOLOG report also found indications for disruptions of the endocrine and the immune system. High frequency electromagnetic fields cause stress reactions, showing up in an increased production of stress hormones in experimental animals and they lead to a reduction of the concentration of the hormone melatonin in the blood of exposed animals and humans. Melatonin has a central control function for the hormone system and the diurnal biological rhythms and it is able to retard the development of certain tumours.

In sum, the ECOLOG report came to dramatically different conclusions than the Stewart Report and called for an immediate downward regulation of the power flux density that should be allowed by the guidelines, by a factor of 1,000

<http://www.hese-project.org/hese-uk/en/niemr/ecologsum.php>

July 2008: U.S.— Dr. Ron Herberman, Director, University of Pittsburgh Cancer Institute, writes memo to staff and students—

“Do not allow children to use a cell phone, except for emergencies.”

“Only use your cell phone to establish contact or for conversations lasting a few minutes, as the biological effects are directly related to the duration of exposure. For longer conversations, use a land line with a corded phone, not a cordless phone, which uses electromagnetic emitting technology similar to that of cell phones.”

http://www.upci.upmc.edu/news/upci_news/072308_celladvisory.cfm

removed

http://old.post-gazette.com/downloads/20080722upci_cellphone_memo.pdf

July 2012: U.S. -- American Academy of Pediatrics to FCC:

“Children are not little adults and are disproportionately impacted by all environmental exposures, including cell phone radiation. In fact, according to IARC, when used by children, the average RF energy deposition is two times higher in the brain and 10 times higher in the bone marrow of the skull, compared with mobile phone use by adults.”

The American Academy of Pediatrics supports Dennis Kucinich’s HR 6358, which calls for biologically-based national standards.

http://kucinich.house.gov/uploadedfiles/aap_support_letter_cell_phone_right_to_know_act.pdf

May 2011, World Health Organization International Agency for Research on Cancer:
Declares radiofrequency electromagnetic radiation to be a Class 2B carcinogen.
This is the same category as lead and DDT.

http://www.iarc.fr/en/media-centre/pr/2011/pdfs/pr208_E.pdf

Biologist Andrew Goldsworthy:

Our present exposure to man-made microwaves is about a million billion billion (one followed by eighteen zeros) times greater than our natural exposure to these frequencies.

The Biological Effects of Weak Electromagnetic Fields, p. 4. March 2012

March 2012: Austrian Medical Association

Releases report "Guideline of the Austrian Medical Association (OAK) for the diagnosis and treatment of EMF-related health problems and illnesses (EMF syndrome)".

In it, they propose setting preliminary "normal" exposure levels at .0001 microW/cm² (microwatts per cm²)—ten million times stricter than current FCC exposure guidelines (200-1000 microW/cm²).

<http://www.aerztekammer.at/documents/10618/976981/EMF-Guideline.pdf>

In 2007, the international Bioinitiative Report was published (www.bioinitiative.org) which included over 1500 peer-reviewed studies on EMF and RF health effects. Now the Bioinitiative 2012 Report has been released:

...(E)vidence for risks to health has substantially increased since 2007 from electromagnetic fields and wireless technologies (radiofrequency radiation). The Report reviews over 1800 new scientific studies. Cell phone users, parents-to-be, young children and pregnant women are at particular risk.

<http://bioinitiative.org/report/wp-content/uploads/pdfs/BioInitiativePressRelease1-1-2013.pdf>

Summary of Key Scientific Evidence:

- Evidence for Damage to Sperm and Reproduction
- Evidence that Children are More Vulnerable
- Evidence for Fetal and Neonatal Effects
- Evidence for Effects on Autism (Autism Spectrum Disorders)
- Evidence for Electrohypersensitivity
- Evidence for Effects from Cell Tower-Level RFR Exposures
- Evidence for Effects on the Blood-brain Barrier
- Evidence for Effects on Brain Tumors
- Evidence for Effects on Genes (Genotoxicity)
- Evidence for Effects on the Nervous System (Neurotoxicity)
- Evidence for Effects on Cancer (Childhood Leukemia, Adult Cancers)
- Melatonin, Breast Cancer and Alzheimer's Disease

- Stress, Stress Proteins and DNA as a Fractal Antenna
- Effects of Weak-Field Interactions on Non-Linear Biological Oscillators and Synchronized Neural Activity
www.bioinitiative.org

In 2007, the German research report Birds, Bees and Mankind: Destroying Nature by Electrosmog was translated into English. Below is an excerpt:

4.2.2 Primary mechanism found: Enzymes transferring electrons are magneto-sensitive

Stimulation of free radicals – including NO (nitrogen monoxide) – through physical fields and radiated fields is therefore scientifically and reliably proven. But viewed critically, this is no proof of damage unless the underlying primary mechanism is identified.

For this reason, we searched for a long time for a link to explain the damaging effect. And we have found it in one of the latest studies: The NADH oxidase enzyme exhibits a high – and quite reproducible – sensitivity for magnetic and electromagnetic fields of mobile phones (FRIEDMAN et al. 2007).

... The NOX family is also responsible for a large range of pathological processes, especially neurodegeneration and heart diseases (BEDARD et al. 2007).

These oxidase enzymes are magnetically sensitive due to their capability of shepherding electrons through plasma membranes. When electrons move, an electrical current flows that in turn builds up its own magnetic field and also generates electromagnetic high frequency oscillations through acceleration and deceleration of electron movement. All these processes create sensitivity to external fields.

The electron transfer is finally responsible for the production of superoxide radicals and other reactive oxygen species (ROS). The consequences of this are far reaching in completely different areas, because radicals and ROS are very aggressive. In this way, the destruction of viruses and bacteria is promoted, the creation of proteins is forced through reinforced gene expression and finally cell proliferation is supported at the cost of cell differentiation.

Over-stimulation is a threat. It is analogous to a drug or medicine: Dosed correctly, the substance can be beneficial; but overdosing can be poisonous. This is exactly what happens with permanent exposure to magnetic and electromagnetic fields.

...Because this mechanism is so important, we shall summarise it in one sentence: The serious pathological disruption is caused by exposure to magnetic and radiated fields resulting in the creation of additional reactive oxygen species (ROS) such as superoxide radicals and hydrogen peroxide, that combine with the increasingly produced NO to form extremely toxic peroxinitrite, that in turn reacts with hydrogens to form more hydrogen peroxide. The consequences of the pathological process are listed further down.

Many vital substances, required for functioning of the body, are rendered useless. If the cascade of effects is disrupted, the normal and healthy effects of NO are restored (HORNIG et al. 2001).

The NADH oxidase is important in another sense as well. It is also found in the cell nucleus where it can – depending on the redox system – control the gene expression, but can also damage genes (MASUKA, 2006).

Bees, Birds and Mankind: Destroying Nature by Electrosmog, Ulrich Warnke, 2007. p. 36.37

http://www.kompetenzinitiative.net/assets/ki_beesbirdsandmankind_print.pdf

January 2012, Electromagnetic Biology and Medicine published research showing 143 proteins in the mammalian brain dysregulated by this radiation, including in regions of the brain important for learning and memory.

Brain proteome response following whole body exposure of mice to mobile phone or wireless DECT base radiation, Fragopoulou et al. Early Online: 1–25, 2012,

<http://www.emfacts.com/2012/01/new-paper-emf-effects-on-mouse-brain-proteome/>
Release

March 2012, research from Yale University showed in-utero exposure to 800-1900 MHz radiation from cell phones (electric Smart Meters are 900 MHz) caused hyperactivity and impaired memory.

Barrie Trower, retired military microwave warfare expert:

13. Debriefing spies during The Cold War extended my military education into the full diversity of stealth microwave warfare and communication systems. In so doing, I learned a list of approximately 30 pulse frequencies that could induce some 50 physical and mental ailments by entrainment.

16. Portland Public Schools are transmitting electromagnetic, specifically MW, frequencies at low exposure levels compared to thermal levels. However, these exposure levels are very high compared to natural background levels at the frequencies deployed: 2.45 GHz and 5 GHz frequency, which means between 2.45 and 5 billion cycles per second. When I realized that power densities and frequencies similar to those used as weapons during the Cold War were being used as WI-FI in schools, I decided to come out of retirement...and explain exactly what the problem is going to be in the future.

Declaration of Barrie Trower, Lawsuit against Portland Public Schools' use of Wi-Fi, December 2011

<http://www.wirelesswatchblog.org/wp-content/uploads/2001/11/20-Amended-Declaration-of-Barry-Trower.pdf>

Trower has now published a report entitled "Wi-Fi in Schools: A Thalidomide in the Making. Who Cares?"

<http://www.electricalpollution.com/documents/WiFiAThalidomideInTheMakingWhoCares.pdf>

USA, 1955 – 1969:

...eleven large conferences took place under the title "Microwaves – Their Biologic Effects and Damages to Health". The so-called Richmond Conference in 1969 presented such overwhelming facts that the ("Program for Control of Electromagnetic Pollution of the Environment", published December 1971) government report had to be compiled. Besides the microwave symptoms

mentioned, gastric bleeding, leukemia, chromosome breakages, cancer, and clouding of the eye lenses were also observed by doctors in the USA.

Overloading of Towns and Cities with Radio Transmitters (Cellular Transmitter), Karl Hecht, Elena N. Savoley, IRCHET International Research Centre of Healthy and Ecological Technology Berlin – Germany
www.hese-project.org/hese-uk/en/niemr/hechtvortrag070724englisch.pdf

Robert C. Kane, senior research scientist and product design engineer for Motorola, 2001:
The bold step back ward is a historical accounting of the research that is available, has been available for forty years or more, and has been neglected or buried by an industry that will place its absolute need to sell products above the health and well-being of its own customers. The practice of producing such products can only be viewed as predatory.

(This book) is a commentary that presents a litany of past research studies, hundreds of research studies from the 1950s through the mid-1990s...These older studies are equally alarming (as current studies) in their findings of radiation exposure, DNA damage, chromosome damage, tissue damage, radiation absorption, cataract formation, tumor formation, memory loss, motor skills degradation, and more. There are many more studies, hundreds that might have been added, but the point is well made by those that are cited without the need to bludgeon the reader with more than what has been presented.

Cellular Telephone Russian Roulette, Robert C. Kane, 2001
<http://microondes.wordpress.com/2010/04/17/robert-c-kane-cellular-telephone-russian-roulette/>

Naval Medical Research Institute, Zorach Glaser, 1972:

Over 2300 references on the biological effects of radio frequency radiation
<http://www.magdahavas.com/2010/07/05/pick-of-the-week-1-more-than-2000-documents-prior-to-1972-on-bioeffects-of-radio-frequency-radiation/>

Karl Hecht, Hans-Ullrich Balzer, 1997,

Report for the German Federal Institute for Telecommunication based on 878 Russian studies from the years 1960-1996.

<http://www.hese-project.org/hese-uk/en/niemr/hechtvortrag070724englisch.pdf>

Research has found impacts including:

DNA damage; calcium ion efflux, where calcium ions leave cell membranes, allowing those membranes to leak; sperm damage and dysfunction; cellular stress; increased risk for cancers and tumors, and cancer clusters around cell towers; seizures; microwave hearing; brain damage, brainwave alteration, and changed brain function; decreased melatonin and other hormones; heart problems, including tachycardia; cataracts; thyroid changes, including thyroid cell death; damage to the blood-brain barrier which keeps toxins and other substances out of the brain, increasing the risk of stroke, auto-immune diseases, and dementia; suspected damage to the blood-

placental barrier, which protects babies; links to autism, ADHD, Alzheimer's, stroke; changes in the blood, including rouleau formation, where RBCs clump together, raising the risk of thrombosis.

Dr. Ulrich Warnke details the devastating results of nitric oxide (NO) system disruption, including the impact to navigating creatures due to the presence of magnetite in their bodies, which is very sensitive to electromagnetic fluctuations. He further details the impacts to bees including to their immune system, sense of smell, learning ability, and navigation:

3.10 Disrupted NO (nitric oxide) system damages learning ability, olfactory orientation and the immune system

...The salient fact is that the NO system is affected by magnetic and electromagnetic oscillations and may in the worst case become totally disrupted – finally destroying molecular functions.

As in mammals, nitric oxide (NO) normally acts as a carrier of information in insects as well. The synthesis and excretion of NO is particularly high in the insect brain. In bees, NO plays a role in the ability to smell and in learning processes (MÜLLER, 1997).

As proven in humans, if the NO system of bees is disrupted through the effect of technical magnetic fields, they lose the ability to orientate themselves by smell and the vital learning programme also becomes defunct. But since NO also materially controls the immune system, disruptions to the NO household always affect the immune defences of the organism as well.

Bees, Birds and Mankind: Destroying Nature by Electrosmog, Ulrich Warnke, 2007. p. 28. 29

http://www.kompetenzinitiative.net/assets/ki_beesbirdsandmankind_print.pdf

And we are witnessing the alarming loss of bees, including through unprecedented disease and the phenomenon of sudden hive collapse, where bees simply don't return to the hive.

The government of India, Ministry of Environment and Forests released a report in 2011 that looked at the impacts of the radiation from cell towers on wildlife, including bees.

...long-term studies have reported alarming observations, detecting negative consequences on immunity, health, reproductive success, behaviour, communication, co-ordination, and niche breadth of species and communities (Preece et al. 2007; Levitt and Lai 2010; Hardell et al. 2008; Hardell et al. 2007; Fernie and Bird 2001).

Report on Possible Impacts of Communication Towers on Wildlife including Birds and Bees, October 2011, p. 4, 6

http://moef.nic.in/downloads/publicinformation/final_mobile_towers_report.pdf

Their study reviewed 919 studies. Of the 919 studies, they found that 593 showed a negative impact of cell towers on birds, bees, human, wildlife and plants, 196 were neutral or inconclusive, and 130 showed no impact.

An experiment with frog tadpoles conducted in a normal city environment near cell towers found 90% mortality and abnormal behavior and reactions in an unshielded aquarium,

compared to 4% mortality and normal behavior and reactions in a shielded aquarium. The study was for 2 months; the majority of the experimental group died within 6 weeks.

Balmori, A. 2010 Mobile Phone Mast Effects on Common Frog – The City Turned into a Laboratory, *Electromagnetic Biology and Medicine* 29: 31–35, 2010
http://citizensforsafetechnology.org/uploads/balmori_city_as_lab1.pdf

A study of storks near cell towers found reproductive problems, aggression among nesting pairs, and infertility.

Balmori, A. 2005. Possible effects of electromagnetic fields from phone masts on a population of white stork. *Electromagnetic Biology and Medicine* 24:109-119
http://www.livingplanet.be/Balmori_EBM_2005.pdf

Government of India report:

House Sparrow (*Passer domesticus*) is associated with human habitation and it is one of the indicator species of urban ecosystems. A declining population of the bird provides a warning that the urban ecosystem is experiencing some environmental changes unsuitable for living in the immediate future (Kumar, 2010). London has witnessed a 75 per cent fall in House Sparrow population since 1994, which coincides with the emergence of the cell-phone (Balmori, 2002). Electromagnetic radiation may be responsible, either by itself or in combination with other factors, for the observed decline of the sparrows in European cities (Balmori, 2009, Balmori & Hallberg, 2007).

p. 14

A study with mice near a cellular antenna park found irreversible sterility after 5 generations. Exposure was between 1.05 to 0.17 microW/cm².

Magras 1997. Radio frequency radiation-induced changes in the prenatal development of mice. *Bioelectromagnetics* 18(6): 455-461.

Germany, 1998:

A study funded by the Bavarian State Government in Germany followed reports of adverse health effects in dairy cattle after a Telecoms mast had been erected for TV and cell phone transmission. Scientists documented a significant drop in milk yield and behavioral disorders in some of the cows that related to the microwave transmissions from the mast. When the cattle were moved to a farm 20 km away, their milk yield and behavior returned to normal within days.

When the cattle were returned to the mast environment their symptoms returned as well. Fodder analysis and the amount of feed could not account for the changes among the cattle. Analysis of aborted fetal material did not find any pathogens causing the abortion based on microscope and cultural examination and on serological tests. Autopsy of dead cows reported acute heart and circulatory collapse with internal bleeding from several organs. Exposure to RFR at the stable entrance was 80 microW/cm² and the highest reading reported on the farm near the stable was 350 microW/cm². These values are much lower than the FCC guideline of 1000 microW/cm².

Löscher and Käs, 1998. Conspicuous behavioural abnormalities in a dairy cow herd near a TV and Radio transmitting antenna.

Practical Veterinary Surgeon 79:5, 437-444.

Cited in Analysis of Health and Environmental Effects of Proposed San Francisco Earthlink Wi-Fi Network:

http://www.buergerwelle.de/pdf/snafu_havas_wifi.pdf

Belyaev (1996) found that microwave radiation altered the genetic structure of e coli bacteria at .0000000000001 microW/cm²; in other words, at 1/10,000,000,000,000th of 1 microW/cm².

http://www.electromagnetic-pollution.com/main/page_biological_effects_exposure_tables.html

Biologist Andrew Goldsworthy:

Trees are now dying mysteriously from a variety of diseases in urban areas all over Europe and are also showing abnormal photoperiodic responses. In addition, many have cancer-like growths under the bark (phloem nodules) and the bark may also split so that the underlying tissues become infected. All of these can be explained as being a result of weak radio-frequency radiation from mobile phones, their base stations, WiFi and similar sources of weak non-ionising radiation. But first let us look at how living organisms use electric currents that they generate themselves and which perform vital functions in their normal day-to-day metabolism and growth. We will then go on to see how weak electromagnetic fields can disrupt these and bring about many unwanted biological effects.

Why Our Urban Trees are Dying, 2011. Dr. Goldsworthy is retired and was an Honorary Lecturer, Imperial College, London

<http://www.mastsanity.org/health/research/299-why-our-urban-trees-aredying-by-andrew-goldsworthy-2011.html>

Wolfgang Volkrodt and Ulrich Hertel

“...There is also this important fact: any tree may act as a receiving dielectric rod or monopole antenna with the ability to both absorb energy from the wave passing by and to scatter the wave in many directions. If the polarization of the transmitting tower antenna matches the particular tree or trees (i.e. vertical orientation of the antenna which is usually the case for collinear dipole arrays on towers), maximum coupling or absorption of the wave energy by the tree will occur. Polarization and conduction currents will generally flow to the root system.

Chapter 11: “Brief Overview of the Effects of Electromagnetic Fields on the Environment” by Raymond S. Kasevich, BSEE, MSE, PE, Registered Professional

Electrical ;Cell Towers: Wireless Convenience or Environmental Hazard? Proceedings of the ‘Cell Towers Forum’ State of the Science/State of the Law, edited by B. Blake Levitt (2001)

Volkrodt provides evidence in his papers that the decimation of forests is not caused by acid rain but by the acidification of the soil due to “electrosmog.”

“Microwaves are ‘received’ by our trees and finally converted into electrical currents which flow into the soil....A type of electric rectification takes place within the cell membranes. In turn, the direct current that spreads from the roots into the soil causes a type of electrolysis. And this, in turn – and not ‘acid rain’ – leads to the soil ‘acidification’ which is being repeatedly observed in the ground under trees exhibiting the new type of forest damage.”

Are Microwaves faced with a fiasco similar to that experienced by nuclear energy? 1991

Official statements by agencies, governments, medical and scientific professionals include:

2002: Germany –

Freiburger Appeal (by 2003, signed by over 2000 healthcare specialists)

<http://www.starweave.com/freiburger/>

December 2005: Austria – Salzburg Region Health Department:

“Official advice is not to use WLAN and DECT in schools or kindergartens.”

<http://www.antennafreeunion.org/salzburg.pdf>

July 2007: Germany -- Federal Government (Bundesregierung) recommends,

“Prefer conventional wired connections, if the use of wireless-supported solutions can be avoided.”

http://www.icems.eu/docs/deutscher_bundestag.pdf

September 2007: Canada -- Green Party

Demands federal action on cell phones and wireless networks

<http://greenparty.ca/releases/27.09.2007>

April 2008: Russian National Committee on Non-Ionizing Radiation Protection:

Publishes international appeal: “Children and Mobile Phones: The Health of the Following Generations is in Danger”

<http://www.kinder-und-mobilfunk.de/downloads/appellrcnirpengl.pdf>

April 2008: France:

Libraries disconnect Wi-Fi, including the National Library and Sorbonne Library.

www.next-up.org/pdf/FranceNationalLibraryGivesUpWiFi07042008.pdf

September 2008, European Parliament:

(Members of the European Parliament) are greatly concerned at the Bio-Initiative international report on electromagnetic fields, which highlights the health risks posed by emissions from mobile-telephony devices such as mobile telephones, UMTS, Wifi, Wimax and Bluetooth, and also DECT landline telephones. It notes that the

limits on exposure to electromagnetic fields which have been set for the general public are obsolete.

<http://www.europarl.europa.eu/sides/getDoc.do?language=en&type=IMPRES S&reference=20080903IPR36136>

May 2011: Council of Europe, Committee on the Environment, Agriculture and Local and Regional Affairs recommends—

“Concerning the protection of children: ban on all mobile phones, DECT phones or WiFi or WLAN systems from classrooms and schools”.

<http://assembly.coe.int/main.asp?Link=/documents/workingdocs/doc11/edoc12608.htm>

January 2012: American Academy of Environmental Medicine, Resolution to California Public Utilities Commission:

“Chronic exposure to wireless radiofrequency radiation is a preventable environmental hazard that is sufficiently well-documented to warrant immediate preventative public health action...”

<http://aaemonline.org/images/CaliforniaPublicUtilitiesCommission.pdf>

January 2012: Austrian Medical Association press release and letter

The planned area-wide introduction of so-called ‘smart meters’, can lead to health consequences, in the opinion of the Department of Environmental Medicine of the Austrian Medical Association (ÖÄK)... The available transmission options such as radio or transmission over the power grid itself (Powerline Communication, short PLC) lead to electrosmog that is harmful to health.

Press Release, February 4, 2012

The expected health consequences would be an increase in symptoms and diseases that fall into the category of so-called multi-system diseases. This illness is characterized by involving several organs or functional systems at the same time and in interaction...

Who is liable in the event of health problems and diseases caused by the increased field exposure on the part of the Smart Meter?...

Letter to Austrian Federal Ministry for Economics, Family and Youth, 1-18-2012

Translated from German <http://www.aerztekammer.at>

March 2012: Swiss MP and physician Dr. Yolanda Gilli --

How high do you estimate the economic costs, for example as a result of the increase of multi-system diseases in area-wide introductions of smart grids, which operate with GSM, WLAN, or PLC?

Radiation risks and Smart Grid, Parliamentary filing (14 co-signers)

http://www.parlament.ch/d/suche/seiten/geschaefte.aspx?gesch_id=20123169

April 2012: Spain –

Ministry of Education defunds national digital classroom program because. "...to fill the classrooms with computers has not demonstrated to be academically profitable," saying there are studies that confirm better results among the students that don't work with computers in class.

http://www.cadenaser.com/sociedad/articulo/educacion-suprime-plan-ordenadores-escuelas-infantiles/csrsrpor/20120404csrsrsoc_3/Tes

July 2012: Israel -- Acting Health Minister writes to Education Minister,

"The process of deployment of wireless internet has to be paused and should (be) reconsidered comprehensively. I do fear that there will come a day that we will all shed tears regarding the irreversible damage that we, in our own hands, cause the future generation."

<http://www.timesofisrael.com/stop-wi-fi-in-schools-deputy-health-minister-implores/>

August 2012: Russia -- National Committee on Non-Ionizing Radiation Protection

"recommend(s) the usage of wired networks in schools and educational institutions, rather than a network using wireless broadband systems, including Wi-Fi...The Russians stand by their solid research which has consistently shown that prolonged exposure to RF/EMF radiation disturbs cognitive function."

<http://iemfa.org/images/pdf/Professor%20Yury%20Grigoriev.pdf>

November 2012: India –

The division bench of Chief Justice Arun Mishra and Justice N K Jain Senior held that radiations emitted from mobile phones and mobile base towers are "hazardous to children and patients", as accepted by the inter-ministerial committee of Central Government, and needs relocation from school, colleges, hospitals and play grounds immediately.

<http://www.deccanherald.com//content/294813/no-mobile-towers-near-schools.html>

Conclusion

The above are examples of statements and actions. They are by no means an exhaustive list.

Project Censored has now included the health impacts of wireless technology as one of the top 25 unreported or underreported stories in its 2014 Yearbook. They titled it, "Wireless Technology A Looming Health Crisis".

<http://www.projectcensored.org/14-wireless-technology-looming-health-crisis/>

Cancer is now the leading cause of death in children, exceeding deaths by accidents.

1 in 5 children now have mental disorders according to the CDC.

<http://atlanta.cbslocal.com/2013/05/18/cdc-1-in-5-us-children-may-have-mental-disorder/>

Neurological deaths doubled in the United States between 1979 and 2010, and neurological illnesses are occurring at younger and younger ages.

Bournemouth University (2013, May 10). Brain diseases affecting more people and starting earlier than ever before. ScienceDaily. Retrieved May 16, 2013, from <http://www.sciencedaily.com/releases/2013/05/130510075502.htm>

There is overwhelming evidence of health and environmental impacts from radiofrequency electromagnetic radiation (RF). There is international clamor from experts and countries warning the public and taking action.

The question is whether this agency will continue to ignore the health and safety of all Americans and our surrounding ecosystem, and the enormous damage occurring right now, or whether it will do the right thing.

Take action now on this long overdue matter before the health and environmental crisis gets far worse, and it becomes too late.

Sincerely,

Nina Beety
Monterey, CA 93940

Additional references:

<http://wifiinschools.org.uk/resources/safeschools2012.pdf>

UK: Report -- Safe Schools 2012 -- on wireless tech

Video: <http://www.youtube.com/watch?v=FO0AnNH8vI>

Wi-Fi in Schools: Testing for Microwave Radiation Dangers in the Classroom

<http://electromagnetichealth.org/electromagnetic-health-blog/cordless-heart/>

Radiation from Cordless Phones Causes Heart Irregularities, According to New Research Published Today in the European Journal of Oncology

www.startribune.com/opinion/commentary/22122349.html

Watch where you're beaming that signal, June 2008 – interference with medical devices

<http://emfsafetynetwork.org/?p=4560>

Dr. Olhoeft interview:

In part two Dr. Olhoeft describes a situation where as he passed through a retail store security system his stimulator was turned off. He shares, "I had to turn myself back on. I have about four seconds to do that before I start shaking so bad I can't do it."

http://www.radiationresearch.org/pdfs/goldsworthy_bio_weak_em_07.pdf

The Biological Effects of Weak Electromagnetic Fields, Andrew Goldsworthy

<http://www.ijoeht.com/index.php/ijoeht/article/view/1309>

International Journal of Occupational and Environmental Health, Vol. 16, No 3
(2010)

Epidemiological Evidence for a Health Risk from Mobile Phone Base Stations,
Khurana et al.

Organizations; EMF Scientist Appeal, International Scientists' Appeal
to the United Nations; 2015



**To: His Excellency Antonio Guterres, Secretary-General of the United Nations;
Honorable Dr. Tedros Adhanom Ghebreyesus, Director-General of the World Health Organization;
Honorable Inger Andersen, Executive Director of the U.N. Environment Programme;
U.N. Member Nations**

International Appeal: Scientists call for Protection from Non-ionizing Electromagnetic Field Exposure

We are scientists engaged in the study of biological and health effects of non-ionizing electromagnetic fields (EMF). Based upon peer-reviewed, published research, we have serious concerns regarding the ubiquitous and increasing exposure to EMF generated by electric and wireless devices. These include—but are not limited to—radiofrequency radiation (RFR) emitting devices, such as cellular and cordless phones and their base stations, Wi-Fi, broadcast antennas, smart meters, and baby monitors as well as electric devices and infra-structures used in the delivery of electricity that generate extremely-low frequency electromagnetic field (ELF EMF).

Scientific basis for our common concerns

Numerous recent scientific publications have shown that EMF affects living organisms at levels well below most international and national guidelines. Effects include increased cancer risk, cellular stress, increase in harmful free radicals, genetic damages, structural and functional changes of the reproductive system, learning and memory deficits, neurological disorders, and negative impacts on general well-being in humans. Damage goes well beyond the human race, as there is growing evidence of harmful effects to both plant and animal life.

These findings justify our appeal to the United Nations (UN) and, all member States in the world, to encourage the World Health Organization (WHO) to exert strong leadership in fostering the development of more protective EMF guidelines, encouraging precautionary measures, and educating the public about health risks, particularly risk to children and fetal development. By not taking action, the WHO is failing to fulfill its role as the preeminent international public health agency.

Inadequate non-ionizing EMF international guidelines

The various agencies setting safety standards have failed to impose sufficient guidelines to protect the general public, particularly children who are more vulnerable to the effects of EMF. The International Commission on Non-Ionizing Radiation Protection (ICNIRP) established in 1998 the “Guidelines For Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields (up to 300 GHz)”¹. These guidelines are accepted by the WHO and numerous countries around the world. The WHO is calling for all nations to adopt the ICNIRP guidelines to encourage international harmonization of standards. In 2009, the ICNIRP released a statement saying that it was reaffirming its 1998 guidelines, as in their opinion, the scientific literature published since that time “has provided no evidence of any adverse effects below the basic restrictions and does not necessitate an immediate revision of its guidance on limiting exposure to high frequency electromagnetic fields”². ICNIRP continues to the present day to make these assertions, in spite of growing scientific evidence to the contrary. It is our opinion that, because the ICNIRP guidelines do not cover long-term exposure and low-intensity effects, they are insufficient to protect public health.

The WHO adopted the International Agency for Research on Cancer (IARC) classification of extremely low frequency magnetic fields (ELF MF) in 2002³ and radiofrequency radiation (RFR) in 2011⁴. This classification states that EMF is a *possible human carcinogen (Group 2B)*. Despite both IARC findings, the WHO continues to maintain that there is insufficient evidence to justify lowering these quantitative exposure limits.

Since there is controversy about a rationale for setting standards to avoid adverse health effects, we recommend that the United Nations Environmental Programme (UNEP) convene and fund an independent multidisciplinary committee to explore the pros and cons of alternatives to current practices that could substantially lower human exposures to RF and ELF fields. The deliberations of this group should be conducted in a transparent and impartial way. Although it is essential that industry be involved and cooperate in this process, industry should not be allowed to bias its processes or conclusions. This group should provide their analysis to the UN and the WHO to guide precautionary action.

Collectively we also request that:

1. children and pregnant women be protected;
2. guidelines and regulatory standards be strengthened;
3. manufacturers be encouraged to develop safer technology;
4. utilities responsible for the generation, transmission, distribution, and monitoring of electricity maintain adequate power quality and ensure proper electrical wiring to minimize harmful ground current;

¹ <http://www.icnirp.org/cms/upload/publications/ICNIRPemfgdl.pdf>

² <http://www.icnirp.org/cms/upload/publications/ICNIRPStatementEMF.pdf>

³ <https://monographs.iarc.fr/wp-content/uploads/2018/06/mono80.pdf>

⁴ <https://monographs.iarc.fr/wp-content/uploads/2018/06/mono102.pdf>

5. the public be fully informed about the potential health risks from electromagnetic energy and taught harm reduction strategies;
6. medical professionals be educated about the biological effects of electromagnetic energy and be provided training on treatment of patients with electromagnetic sensitivity;
7. governments fund training and research on electromagnetic fields and health that is independent of industry and mandate industry cooperation with researchers;
8. media disclose experts' financial relationships with industry when citing their opinions regarding health and safety aspects of EMF-emitting technologies; and
9. white-zones (radiation-free areas) be established.

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Inquiries, including those from qualified scientists who request that their name be added to the Appeal, may be made by contacting Elizabeth Kelley, M.A., Director, EMFscientist.org, at info@EMFscientist.org.

Note: the signatories to this appeal have signed as individuals, giving their professional affiliations, but this does not necessarily mean that this represents the views of their employers or the professional organizations they are affiliated with.

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Organizations; 5G Appeal, Scientist Appeal to the EU, Scientists Warn of Potential
Serious Health Effects of 5G; 2017



Scientists warn of potential serious health effects of 5G

September 13, 2017

We the undersigned, more than 180 scientists and doctors from 35 countries, recommend a moratorium on the roll-out of the fifth generation, 5G, for telecommunication until potential hazards for human health and the environment have been fully investigated by scientists independent from industry. 5G will substantially increase exposure to radiofrequency electromagnetic fields (RF-EMF) on top of the 2G, 3G, 4G, Wi-Fi, etc. for telecommunications already in place. RF-EMF has been proven to be harmful for humans and the environment.

(Note: [Blue links](#) below are references.)

5G leads to massive increase of mandatory exposure to wireless radiation

5G technology is effective only over short distance. It is poorly transmitted through solid material. Many new antennas will be required and full-scale implementation will result in antennas every 10 to 12 houses in urban areas, **thus massively increasing mandatory exposure.**

With "[the ever more extensive use of wireless technologies](#)," nobody can avoid to be exposed. Because on top of the increased number of 5G-transmitters (even within housing, shops and in hospitals) according to estimates, "[10 to 20 billion connections](#)" (to refrigerators, washing machines, surveillance cameras, self-driving cars and buses, etc.) will be parts of the Internet of Things. All these together can cause a substantial increase in the total, long term RF-EMF exposure to all EU citizens.

Harmful effects of RF-EMF exposure are already proven

[More than 230 scientists from 41 countries](#) have expressed their "serious concerns" regarding the ubiquitous and increasing exposure to EMF generated by electric and wireless devices already before the additional 5G roll-out. They refer to the fact that "numerous recent scientific publications have shown that *EMF affects living organisms at levels well below most international and national guidelines*". Effects include increased cancer risk, cellular stress, increase in harmful free radicals, genetic damages, structural and functional changes of the reproductive system, learning and memory deficits, neurological disorders, and negative impacts on general well-being in humans. Damage goes well beyond the human race, as there is growing evidence of harmful effects to both [plants](#) and [animals](#).

After the scientists' appeal was written in 2015 additional research has convincingly confirmed serious health risks from RF-EMF fields from wireless technology. The world's largest study (25 million US dollar) [National Toxicology Program \(NTP\)](#), shows statistically significant increase in the incidence of *brain and heart cancer* in animals exposed to EMF below the ICNIRP (International Commission on Non-Ionizing Radiation Protection) guidelines followed by most countries. These results support results in human epidemiological studies on RF radiation and brain tumour risk. [A large number of peer-reviewed scientific reports](#) demonstrate harm to human health from EMFs.

The International Agency for Research on Cancer (IARC), the cancer agency of the World Health Organization (WHO), in 2011 concluded that EMFs of frequencies 30 KHz – 300 GHz are possibly [carcinogenic to humans \(Group 2B\)](#). However, new studies like the NTP study mentioned above and several epidemiological investigations including the latest studies on mobile phone use and brain cancer risks [confirm that RF-EMF radiation is carcinogenic to humans](#).

The [EUROPA EM-EMF Guideline 2016](#) states that "there is strong evidence that *long-term exposure to certain EMFs is a risk factor for diseases* such as certain cancers, Alzheimer's disease, and male infertility...Common EHS (electromagnetic hypersensitivity) symptoms include headaches, concentration difficulties, sleep problems, depression, lack of energy, fatigue, and flu-like symptoms."

An increasing part of the European population is affected by ill health symptoms that have for many years been linked to exposure to EMF and wireless radiation in the scientific literature. The International [Scientific Declaration on EHS & multiple chemical sensitivity \(MCS\)](#), Brussels 2015, declares that: "In view of our present scientific knowledge, we thereby stress all national and international bodies and institutions...to recognize EHS and MCS as true medical conditions which acting as sentinel diseases may create a *major public health concern in years to come worldwide* i.e. in all the countries implementing unrestricted use of electromagnetic field-based wireless technologies and marketed chemical substances... ***Inaction is a cost to society*** and is not an option anymore... we unanimously acknowledge this serious hazard to public health...that major primary *prevention measures are adopted and prioritized, to face this worldwide pan-epidemic in perspective.*"

Precautions

The [Precautionary Principle](#) (UNESCO) was [adopted by EU 2005](#): "When human activities may lead to morally unacceptable harm that is scientifically plausible but uncertain, actions shall be taken to avoid or diminish that harm."

[Resolution 1815](#) (Council of Europe, 2011): "Take all reasonable measures to reduce exposure to electromagnetic fields, especially to radio frequencies from mobile phones, and particularly the exposure to children and young people who seem to be most at risk from head tumours...Assembly strongly recommends that the ALARA (as low as reasonably achievable) principle is applied, covering both the so-called thermal effects and the athermic [non-thermal] or biological effects of electromagnetic emissions or radiation" and to "improve risk-assessment standards and quality".

The [Nuremberg code](#) (1949) applies to all experiments on humans, thus including the roll-out of 5G with new, higher RF-EMF exposure. All such experiments: "should be based on previous knowledge (e.g., an expectation derived from animal experiments) that justifies the experiment. No experiment should be conducted, *where there is an a priori reason to believe that death or disabling injury will occur*; except, perhaps, in those experiments where the experimental physicians also serve as subjects." (Nuremberg code pts 3-5). Already published scientific studies show that there is "a priori reason to believe" in real health hazards.

The [European Environment Agency](#) (EEA) is warning for "Radiation risk from everyday devices" in spite of the radiation being [below the WHO/ICNIRP standards](#). EEA also concludes: "There are many examples of the failure to use the precautionary principle in the past, which have *resulted in serious and often irreversible damage to health and environments*...harmful exposures can be widespread before there is both 'convincing' evidence of harm from long-term exposures, and biological understanding [\[mechanism\]](#) of how that harm is caused."

"Safety guidelines" protect industry – not health

The current ICNIRP "safety guidelines" are obsolete. All proofs of harm mentioned above arise although the radiation is [below the ICNIRP "safety guidelines"](#). Therefore new safety standards are necessary. The reason for the misleading guidelines is that "[conflict of interest of ICNIRP members](#) due to their *relationships with telecommunications or electric companies* undermine the impartiality that should govern the regulation of Public Exposure Standards for non-ionizing radiation...To evaluate cancer risks it is necessary to include scientists with competence in medicine, especially oncology."

The current ICNIRP/WHO guidelines for EMF are based on the obsolete hypothesis that "The critical effect of RF-EMF exposure relevant to human health and safety is [heating of exposed tissue](#)." However, scientists have proven that many different kinds of *illnesses and harms are* [caused without heating](#) ("non-thermal effect") at radiation levels well below ICNIRP guidelines.

We urge the EU:

- 1) To take all reasonable measures to halt the 5G RF-EMF expansion until independent scientists can assure that 5G and the total radiation levels caused by RF-EMF (5G together with 2G, 3G, 4G, and WiFi) will not be harmful for EU-citizens, especially infants, children and pregnant women, as well as the environment.
- 2) To recommend that all EU countries, especially their radiation safety agencies, follow Resolution 1815 and inform citizens, including, teachers and physicians, about health risks from RF-EMF radiation, how and why to avoid wireless communication, particularly in/near e.g., daycare centers, schools, homes, workplaces, hospitals and elderly care.
- 3) To appoint immediately, without industry influence, an EU task force of independent, truly impartial EMF-and-health scientists with no conflicts of interest¹ to re-evaluate the health risks and:
 - a) To decide about new, safe “maximum total exposure standards” for all wireless communication within EU.
 - b) To study the total and cumulative exposure affecting EU-citizens.
 - c) To create rules that will be prescribed/enforced within the EU about how to avoid exposure exceeding new EU “maximum total exposure standards” concerning all kinds of EMFs in order to protect citizens, especially infants, children and pregnant women.
- 4) To prevent the wireless/telecom industry through its lobbying organizations from persuading EU-officials to make decisions about further propagation of RF radiation including 5G in Europe.
- 5) To favor and implement wired digital telecommunication instead of wireless.

We expect an answer from you no later than **October 31, 2017** to the two first mentioned signatories about what measures you will take to protect the EU-inhabitants against RF-EMF and especially 5G radiation. This appeal and your response will be publicly available.

Respectfully submitted,

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WE will add signatories to the following list through the end of 2017. The updated list of signatories and the appeal can be found later [HERE](#).



¹ Avoid similar mistakes as when the [Commission \(2008/721/EC\)](#) appointed [industry supportive members for SCENIHR](#), who submitted to EU [a misleading SCENIHR report](#) on health risks, [giving telecom industry a clean bill to irradiate](#) EU-citizens. The report is now quoted by radiation safety agencies in EU.

Signatories to the 5G Appeal (As of September 13, 2017)

Note: The endorsements are personal and not necessarily supported by the affiliated universities or organizations.

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Organizations; Medical Doctors and Public Health Organizations:
Consensus Statements and Doctors' Recommendations on
Cell Phones/Wireless; 2017



Medical Doctors and Public Health Organizations
(last update April 26, 2017)

Consensus Statements and Doctors' Recommendations on Cell Phones/Wireless

It is a fact that *not a single medical organization* states that cell phone/wireless radiation is safe. There is no proof of safety.

American Academy of Pediatrics

The American Academy of Pediatrics (AAP), is a non-profit professional organization of 60,000 primary care pediatricians, pediatric medical subspecialists, and pediatric surgical specialists dedicated to the health, safety and well-being of infants, children, adolescents, and young adults.

[2016: American Academy of Pediatrics Website - Healthy Children.org. "Cell Phone Radiation & Children's Health: What Parents Need to Know".](#)

- In response to the National Toxicology Program Cell Phone Radiation Study results, the AAP issued the following cell phone safety tips specifically to reduce exposure to wireless radiation in 2016:
- Use text messaging when possible, and use cell phones in speaker mode or with the use of hands-free kits.
- When talking on the cell phone, try holding it an inch or more away from your head.
- Make only short or essential calls on cell phones.
- Avoid carrying your phone against the body like in a pocket, sock, or bra. Cell phone manufacturers can't guarantee that the amount of radiation you're absorbing will be at a safe level.
- Do not talk on the phone or text while driving. This increases the risk of automobile crashes.
- Exercise caution when using a phone or texting while walking or performing other activities. "Distracted walking" injuries are also on the rise.
- If you plan to watch a movie on your device, download it first, then switch to airplane mode while you watch in order to avoid unnecessary radiation exposure.
- Keep an eye on your signal strength (i.e. how many bars you have). The weaker your cell signal, the harder your phone has to work and the more radiation it gives off. It's better to wait until you have a stronger signal before using your device.
- Avoid making calls in cars, elevators, trains, and buses. The cell phone works harder to get a signal through metal, so the power level increases.
- Remember that cell phones are not toys or teething items.
- [Press release on AAP Recommendations](#)

[Press Release May 27, 2016: "The AAP responds to study showing link between cell phone radiation, tumors in rats"](#)

"They're not toys. They have radiation that is emitted from them and the more we can keep it off the body and use (the phone) in other ways, it will be safer," said Jennifer A. Lowry, M.D., FAACT, FAAP, chair of the AAP Council on Environmental Health Executive Committee.

[2015 AAP Healthy Child Webpage - "Electromagnetic Fields: A Hazard to Your Health?"](#)

This webpage states:

"Cell Phones: In recent years, concern has increased about exposure to radiofrequency electromagnetic radiation emitted from cell phones and phone station antennae. An Egyptian study confirmed concerns that living nearby mobile phone base stations increased the risk for developing: *Headaches, Memory problems, Dizziness, Depression, Sleep problems*"

[2013 AAP Letter to FCC Commissioner Mignon Clyburn and FDA Commissioner Margaret Hamburg calling for a review of RF guidelines 8/29/2013](#)

"The AAP urges the FCC to adopt radiation standards that: Protect children's health and well-being. Children are not little adults and are disproportionately impacted by all environmental exposures, including cell phone radiation. Current FCC standards do not account for the unique vulnerability and use patterns specific to pregnant women and children. It is essential that any new standard for cell phones or other wireless devices be based on protecting the youngest and most vulnerable populations to ensure they are safeguarded throughout their lifetimes."

[2012 AAP Letter to US Representative Dennis Kucinich in Support of the Cell Phone Right to Know Act 12/12/2012](#)

"The differences in bone density and the amount of fluid in a child's brain compared to an adult's brain could allow children to absorb greater quantities of RF energy deeper into their brains than adults. It is essential that any new standards for cell phones or other wireless devices be based on protecting the youngest and most vulnerable populations to ensure they are safeguarded through their lifetimes."

["Time Magazine \(2012\): Pediatricians Say Cell Phone Radiation Standards Need Another Look"](#)

[2012, the AAP published Pediatric Environmental Health, Textbook of Children's Environmental Health, Chapter 41: Electromagnetic Fields, pg. 384](#)

"Exposures can be reduced by encouraging children to use text messaging when possible, make only short and essential calls on cellular phones, use hands free kits and wired headsets and maintain the cellular phone an inch or more away from the head."

AAP News 2011: [*"More study needed on risk of brain tumors from cell phone use"*](#)

Maryland Children's Environmental Health and Protection Advisory Council

2017: The Children's Environmental Health and Protection Advisory Council recommends:

1. "The Maryland State Department of Education should recommend that local school systems consider using wired devices" "WiFi can be turned off" and instead "a wired local area network (LAN) can provide a reliable and secure form of networking...without any microwave electromagnetic field exposure."
2. New school construction and renovations to include wired cabled connections: "If a new classroom is to be built, or electrical work is to be carried out in an existing classroom, network cables can be added at the same time, providing wired (not wireless) network access with minimal extra cost and time."
3. The Maryland State Department of Education should recommend that local school systems use strategies to minimize exposures: "Have children place devices on desks to serve as barrier between the device and children's bodies; Locate laptops in the classroom in a way that keeps pupil heads as far away from the laptop screens (where the antennas are) as practicable; Consider using screens designed to reduce eyestrain; Consider using a switch to shut down the router when it is not in use."
4. "The Maryland Department of Health and Mental Hygiene should provide suggestions to the public on ways to reduce exposure: Sit away from WiFi routers, especially when people are using it to access the internet. Turn off the wireless on your laptop when you are not using it. Turn off WiFi on smartphones and tablets when not surfing the web. Switch tablets to airplane mode to play games or watch videos stored on the device."
5. "The General Assembly should consider funding education and research on electromagnetic radiation and health as schools add WiFi to classrooms."
6. The Maryland Department of Health and Mental Hygiene should "ask the United States Department of Health and Human Services to formally petition the FCC to revisit the exposure limit to ensure it is protective of children's health and that it relies on current science."
7. The Report should be shared with the United States Department of Health and Human Services, Federal Communications Commission, Maryland State Department of Education and Maryland General Assembly.

[Final Report of the Maryland Children's Environmental Health and Protection Advisory Council](#)
[Letters from Physicians on Wireless Health Risks in Public Comments](#)
[Press Release 3/3/2017](#)

The BabySafe Project

As of August 2016 over 200 physicians, scientists and public health professionals from around the world have signed onto this Project "to express their concern about the risk that wireless radiation poses to pregnancy and to urge pregnant women to limit their exposures."

- [The BabySafe Project Website](#)

Environmental Health Trust <http://ehtrust.org/>

- “We call on our elected leaders to support such research and to advance policies and regulations that limit exposures for pregnant women. We call on industry to implement and explore technologies and designs that will reduce radiation exposures until such research is carried out.”
- The BabySafe Project Brochure [“Ten Ways to Reduce Your Wireless Exposure”](#) which includes “Whenever possible, connect to the internet with wired cables”.
- EPA Award: The BabySafe Project was recognized in the [US EPA” 2016 Children's Environmental Health Excellence Award from the EPA's Office of Children's Health Protection](#). Patricia Wood was awarded based on three distinct initiatives including “the creation and development of the BabySafe Project, a program designed to inform doctors, neonatal health professionals and parents about the potential risks that wireless radiation poses to pregnancy”.

Maryland State Children’s Environmental Health And Protection Advisory Council

2017 Recommendations For Wired Internet In School Classrooms:

[The Maryland State Children’s Environmental Health and Protection Advisory Council](#) (CEHPAC) issued a Report advising the Department of Education to recommend local school districts reduce classroom wireless radiation exposures by providing wired—rather than wireless—internet connections. CEHPAC’s health experts include Governor appointed pediatricians, Maryland State House/Senate appointees and representatives of the Department of Education and Department of Health.

[Wifi Radiation in Schools in Maryland Final Report](#)

[Letters from Physicians CEHPAC’s Public Comments](#)

[Testimony to the Maryland State Children’s Environmental Health and Protection Advisory Council Selections of Testimony](#)

[Testimony to Maryland State Board of Education](#)

[Testimony of a High School Student to the Board of Education](#)

The California Medical Association

The California Medical Association (CMA) passed a Wireless Resolution in 2014 that states :

“Whereas scientists are increasingly identifying EMF from wireless devices as a new form of environmental pollution ...

Whereas peer reviewed research has demonstrated adverse biological effects of wireless EMF including single and double stranded DNA breaks, creation of reactive oxygen species, immune dysfunction, cognitive processing effects, stress protein synthesis in the brain, altered brain development, sleep and memory disturbances, ADHD, abnormal behavior, sperm dysfunction, and brain tumors; and...Resolved, That CMA support efforts to implement new safety exposure limits for wireless devices to levels that do not cause human or environmental harm based on scientific research.”

[Read the full CMA Resolution here.](#)

[Read a the Santa Clara Medical Bulletin article by Dr. Cindy Russell that explains the CMA resolution and gives recommendations for schools.](#)

Athens Medical Association

On April 1st 2017 the Athens Medical Association voted to issue 16 recommendations to reduce human exposure to wireless radiation. [Read the press release here.](#)

16 RULES FOR SAFER USE OF WIRELESS COMMUNICATION

- Use your cell phone with caution and make brief calls as necessary
- Children under the age of 14 should make limited use of cell phones
- Do not put your cell phone in contact with your head
- Do not use your cell phone inside a car, train, aeroplane, or elevator
- Restrict cell phone use when children or pregnant women are near
- Keep mobile phones away from your body
- When using your cell phone keep a safe distance from others
- Do not carry or keep your cell phone inside your pockets
- At bedtime, disable WiFi on your router and switch off your mobile phone
- Do not play games on-line; and if you will, first switch to airplane mode
- Hands-Free option is always preferable though may not be completely safe
- Wireless connections may increase your exposure to microwave radiation
- Limit WiFi connectivity and use hard-wired connection whenever possible
- When signal strength is weak do not attempt to make a call
- If a corded landline is available make use of this as a preferred option
- Disable WiFi, Bluetooth & Data options from your cell phone and other mobile device(s) when not needed.

The Vienna Medical Association

The Vienna Medical Association has issued [Ten Medical Rules for Cell Phones](#) which includes:

“Make calls as short and little as possible, Do not position mobile phones directly on the body , Fewer apps means less radiation, Make calls at home and at work via the fixed corded (not wireless) network - Internet access via LAN cable, Constant radiation emitters like DECT cordless telephones, WLAN access points, data sticks and LTE Home base stations (Box, Cube etc.) should be avoided! Avoid Mobile phone calls in places with poor reception ”

“The radiation from mobile phones or smartphones is most likely not as safe as cell phone providers claim it to be. Therefore, the Vienna Medical Association has decided to do the responsible thing and inform the Austrian public about possible adverse effects from a medical perspective.”

The Connecticut Department of Public Health, USA

Public Health Department recommendations to reduce exposure to cellphone radiation. 7 steps on *how* people can reduce exposure.

“It is wise to reduce your exposure to radiofrequency energy from cell phones whenever possible.” [Read the Connecticut Department of Public Health Cell Phone Q and A about Cell phones here.](#)

The Massachusetts Department of Health, USA

Environmental Health Trust <http://ehtrust.org/>

BEST PRACTICES IN THE USE OF WIRELESS TECHNOLOGY Dr. Robert S. Knorr Director,
Environmental Epidemiology Program Bureau of Environmental Health, Massachusetts
Department of Public Health

- “Below are common recommendations and include those for both cell phone and non-cell phone sources:
- Use wired communication devices instead of wireless devices
- Limit children’s use of cell phones except for emergencies
- Keep cell phones and other sources at a distance
- If using wireless devices like computers, laptops, tablets, and printers, place the wireless router away from where children and adults usually spend time.

The French National Agency of Health Security of Food, Environment and Labour

2016 Report “Radiofrequency Exposure and the Health of Children” recommends reducing exposures to young children and strengthening regulations to ensure “sufficiently large safety margins” to adequately protect the health of young children.

- All wireless devices, including tablets, cordless phones, remote controlled toys, wireless toys, baby monitors and surveillance bracelets, should be subjected to the same regulatory obligations as cell phones.
- Compliance with regulatory exposure limits should be insured for the ways that devices are customarily used, such as positioned in contact with the body.
- Exposure limits for radiofrequency electromagnetic fields should be tightened to ensure sufficiently large safety margins to protect the health and safety of the general population, particularly the health and safety of children.
- Reliance on the specific absorption rate (SAR) to set human exposure limits should be re-evaluated and replaced through the development of an indicator to assess real exposures for mobile phone users that applies to various conditions: signal type, good or bad reception, mode of use (call, data loading, etc.), location device is used on the body.
- ANSES reiterated its recommendation, as previously stated, to reduce exposure to children: minimize use and prefer a hands-free kit.

2013 Report “Radiofrequency Electromagnetic Fields and Health” Expert Appraisal: hands free phones, SAR labeling, and “limiting the population’s exposure to radiofrequencies... especially for children and intensive users, and controlling the overall exposure that results from relay antennas.”

The American Cancer Society (ACS) - 2016 ACS Responds to New Study Linking Cell Phone Radiation to Cancer

“The NTP report linking radiofrequency radiation (RFR) to two types of cancer marks a paradigm shift in our understanding of radiation and cancer risk. The findings are unexpected; we wouldn’t reasonably expect non-ionizing radiation to cause these tumors. This is a striking example of why serious study is so important in evaluating

cancer risk. It's interesting to note that early studies on the link between lung cancer and smoking had similar resistance, since theoretical arguments at the time suggested that there could not be a link." -Otis W. Brawley, M.D., The American Cancer Society Chief Medical Officer

[2009 Lecture at Cell Phones and Health Conference](#): In 2009 Michael Thun, Vice President of the American Cancer Society, lectured on cell phone radiation and cancer risk and detailed how it would take decades before definitive evidence is found in the general population due to the slow growing nature of brain cancer but that early signs would be seen in increases in gliomas

Canadian Parliament Standing Committee on Health of the House of Commons - 2015
Canadian Parliament Report "[Radio Frequency Electromagnetic Radiation and the Health of Canadians](#)"

- The report has 12 recommendations including "That the Government of Canada develop an awareness campaign relating to the safe use of wireless technologies, such as cell phones and Wi-Fi, in key environments such as the school and home to ensure that Canadian families and children are reducing risks related to radiofrequency exposure."

Environment and Human Health, Inc.

[Cell Phones: Technology, Exposures, Health Effects by Environment and Human Health, Inc.](#)

John Wargo, Ph.D., professor of Environmental Risk and Policy at Yale University and lead author of the report, said, "*The scientific evidence is sufficiently robust showing that cellular devices pose significant health risks to children and pregnant women. The weight of the evidence supports stronger precautionary regulation by the federal government. The cellular industry should take immediate steps to reduce emission of electromagnetic radiation (EMR) from phones and avoid marketing their products to children.*"

- [Download Full Text of Report](#)
- [Summary](#)
- [Recommendations](#)
- [Press Release](#)

The Council of Europe

In 2011 The Parliamentary Assembly of the Council of Europe issued Resolution 1815:

[The Potential Dangers of Electromagnetic Fields and Their Effect on the Environment](#)

- A call to European governments to "take all reasonable measures" to reduce exposure to electromagnetic fields "particularly the exposure to children and young people who seem to be most at risk from head tumours."
- "*For children in general, and particularly in schools and classrooms, give preference to wired Internet connections, and strictly regulate the use of mobile phones by schoolchildren on school premises.*"

(Note: This is a follow up to the 2009 European Parliament's [Health concerns associated](#)

Environmental Health Trust <http://ehtrust.org/>

with electromagnetic fields).

2015 International Scientists Appeal to U.N. to Protect Humans and Wildlife from Electromagnetic Fields and Wireless Technology EMF Scientists

- In May 2015, a group of over 200 scientists from 39 nations who have authored more than 2,000 articles on this topic appealed to the United Nations to address “the emerging public health crisis” related to cell phones and other wireless devices. These scientists state that “the ICNIRP guidelines do not cover long-term exposure and low-intensity effects, and are “insufficient to protect public health.”
- They state that “the various agencies setting safety standards have failed to impose sufficient guidelines to protect the general public, particularly children who are more vulnerable to the effects of EMF.”

The World Health Organization’s International Agency for Research on Cancer

The WHO/IARC classified all radiofrequency electromagnetic fields as “possibly carcinogenic to humans” in 2011 based on the opinion of a Working Group of 31 international experts who met in Lyon, France in May, 2011 based largely on positive associations have been observed between exposure to radiofrequency radiation from wireless phones and glioma, and acoustic neuroma.” ([p. 421](#))

- Read article in [The Lancet IARC 2011 on the classification](#),
- Read the [The 2011 IARC Press Release by the WHO IARC](#) in which precautions are recommended:

“Given the potential consequences for public health of this classification and findings, it is important that additional research be conducted into the long- term, heavy use of mobile phones. Pending the availability of such information, it is important to take pragmatic measures to reduce exposure such as hands-free devices or texting.”said IARC Director Christopher Wild.
- Read the [published the IARC Monograph on Non-Ionizing Radiation, Part 2: Radiofrequency Electromagnetic Fields](#) (April 2013) with scientific basis for classification.
 - “Due to the closer proximity of the phone to the brain of children compared with adults, the average exposure from use of the same mobile phone is higher by a factor of 2 in a child’s brain and higher by a factor of 10 in the bone marrow of the skull.”

Swiss Physicians Association of Doctors for Environmental Protection

- [2012 Swiss Physicians Letter](#) “the risk of cancer for this type of [wireless] radiation is similar to that of the insecticide DDT, rightfully banned... From the medical point of view, it is urgent to apply the precautionary principle for mobile telephony, WiFi, power lines, etc.”
- [2014: Preliminary draft for a federal law on the protection against dangers:](#) Non-ionizing radiation (NIS) is growing steadily. Especially the everyday stress in the area of low-frequency and high-frequency.

- [2016: Press Release on the NTP Study and Policy Implications](#): “There are increasingly clear indications that mobile radio is a health hazard. From a medical point of view it is clear: the scientific results so far show it is clear that prudent avoidance of unnecessary exposures is necessary.”
- Additional Links by Swiss Physicians for the Environment
Report on [Smartphones- \(OEKOSKOP 1/16\)](#) [AefU-News about Electrosmog](#)

Dr. Eitan Kerem, Chairman, Department of Pediatrics at Hadassah Hebrew University Hospital

In response to the 2016 NIH/NIEHS/NTP Study results finding a link between RF-EMF and Cancer, Dr. Kerem issued a statement which includes:

“It is well known that children are more sensitive to radiation than adults; many of them are using cellphone and other radiating media more frequently than adults. The effect of radiation is accumulative and this may have long term effect on the growing child. Such findings in the pharma industry may prevent further developing of a drug until safety is proven, and until the findings of this study are confirmed parents should be aware of the potential hazards of carcinogenic potential of radiofrequency radiation.” [Read the Statement by Dr. Eitan Kerem, Hadassah Hebrew University Hospital](#)

The American Academy of Environmental Medicine

[The American Academy of Environmental Medicine's Open Letter to the Superintendents of the School Districts of the United States](#)

"Adverse health effects, such as learning disabilities, altered immune responses, headaches, etc. from wireless radio frequency fields do exist and are well documented in the scientific literature. Safer technology, such as using hard-wiring, must be seriously considered in schools for the safety of those susceptible individuals who may be affected by this phenomenon. "

[Wireless Radiofrequency Radiation in Schools](#)

[American Academy of Environmental Medicine Recommendations Regarding Electromagnetic and Radiofrequency Exposure](#)

[Letter to the FCC regarding Radiofrequency Exposure Limits.](#)

International Society of Doctors for the Environment

ISDE has made the following recommendations: Avoid Wi-Fi in home or work if possible, particularly in schools or hospitals and Use wired technology whenever possible.

- “Because of the potentially increased risks for the foetus, infants and young children due to their thinner more permeable skulls and developing systems, particularly the immune and neurological systems, based on the precautionary principle and on the mounting evidence for harm at the sub-cellular level, we recommend that EMR exposure should be kept to a minimum.”
- [Read the Statement Here.](#)

Environmental Health Trust <http://ehtrust.org/>

Irish Doctors Environmental Association

The Irish Doctors Environmental Association wrote a statement in 2013 concerning health concerns with Wi-Fi in school:

“We urge you to use wired technologies for your own safety and that of your pupils and staff.” [Read the 2013 Letter](#)

Bioinitiative Working Group

[Bioinitiative 2012 Report](#): A report by [29 independent scientists and health experts](#) from around the world* about possible risks from wireless technologies and electromagnetic fields.

“The science, public health, public policy and global response to the growing health issue of chronic exposure to electromagnetic fields and radiofrequency radiation in the daily life of billions of people around the world. Covers brain tumor risks from cell phones, damage to DNA and genes, effects on memory, learning, behavior, attention; sleep disruption and cancer and neurological diseases like Alzheimer’s disease. Effects on sperm and miscarriage (fertility and reproduction), effects of wireless on the brain development of the fetus and infant, and effects of wireless classrooms on children and adolescents is addressed. Mechanisms for biological action and public health responses in other countries are discussed. Therapeutic use of very low intensity EMF and RFR are addressed.”

[Henry Lai’s Research Summaries](#): These abstracts (data-based to be searchable) cover the RFR scientific literature from both RFR and ELF on research published between 1990-2012.

[The Bioinitiative RF Color Charts](#) summarize many studies that report biological effects and adverse health effects relevant for cell towers, WI-FI, 'smart' wireless utility meters, wireless laptops, baby monitors, cell phones and cordless phones. The reader can compare the level of EMF used in specific research studies relative to the health effect.

[Bioinitiative Letter to Education Super Highway CEOs](#) the Co-Editors of the Bioinitiative Report Cindy Sage and David Carpenter sent a letter on behalf of the Bioinitiative Working Group to the CEO's on the health risks of wireless infrastructure in US schools stating:

“WiFi in schools, in contrast to wired internet connections, will increase risk of neurologic impairment and long-term risk of cancer in students. Corporations cannot avoid responsibility simply by asserting compliance with existing legal, but outdated and inadequate FCC public safety limits. Today, corporations that deal with educational technology should be looking forward and helping school administrators and municipal leaders to access safe, wired solutions.”

Austrian Medical Association

[Guidelines of the Austrian Medical Association for the diagnosis and treatment of EMF related health problems and illnesses \(EMF syndrome\)](#): The Austrian Medical Association, on March 3, 2012, released their guide for diagnosing and treating people with EMF-related health problems.

Environmental Health Trust <http://ehtrust.org/>

"Wi-Fi environments will lead to high microwave exposure for students and teachers which might increase the burden of oxidative stress. Oxidative stress might slow down the energy production especially in brain cells and may lead e.g. to concentration difficulties and memory problems in certain individuals. The Austrian Medical Association recommends Wi-Fi free school environments."

Dr Gerd Oberfeld, MD, Public Health Department, Salzburg, Austria, on behalf of the Austrian Medical Association stated, "Schools should provide the best possible learning environments. In this context low noise levels, good air quality and low radiofrequency / microwave radiation are crucial. Wi-Fi environments will lead to high microwave exposure for students and teachers which might increase the burden of oxidative stress. Oxidative stress might slow down the energy production especially in brain cells and may lead e.g. to concentration difficulties and memory problems in certain individuals. The Austrian Medical Association recommends Wi-Fi free school environments".

[Consumers Protection Association of Romania on Cell Phones and Wireless](#)

The Association for Consumer Protection in Romania Has 13 Recommendations to the Public on Cell Phones and Wireless

1. Do not allow children younger than 12 years how to use a cell phone, except for emergencies. Developing bodies are more susceptible to negative influences from exposure to electromagnetic fields.
2. Limit cell phone use calls the most important and limit the length of calls. The biological effects are directly related to the duration of exposure; research results have shown that only a two-minute conversation modifies the natural electrical activity of the brain for up to an hour after that call. Communicate via SMS rather than by telephone (it limits the duration of exposure and the proximity of the body).
3. During the call, hold the phone a body as large . Regularly change the head of the supported phone or, better yet, switch to speakerphone that allows the user to hold the phone away from the head (amplitude field drops 4 times at a distance of 10 cm and 50 times a 1 m distance).
4. [Read The Full List here.](#)

Center for Environmental Oncology University of Pittsburgh Cancer Institute

[Frequently Asked Questions about Cancer and the Environment](#) recommends reducing exposure.

Dr. Ronald B. Herberman, Director of the University of Pittsburgh Cancer Institute, issued a [Memo to PCI Staff: Important Precautionary Advice Regarding Cell Phone Use](#)

“Do not allow children to use a cell phone, except for emergencies. The developing organs of a fetus or child are the most likely to be sensitive to any possible effects of exposure to electromagnetic fields”.

- [Prominent Cancer Doctor Warns About Cellphones](#): New York Times article
- [Statement Of Ronald B. Herberman, MD Director University of Pittsburgh Cancer Institute and UPMC Cancer Centers](#) to the Domestic Policy Subcommittee Oversight and Government Reform Committee Thursday, September 25, 2008 2154 Rayburn HOB 11:00 a.m. “Tumors and Cell Phone use: What the Science Says”

The Cancer Association of South Africa (CANSA)

“In order to prove that the use of cell phones can cause cancer, many thousands of cell phone users would need to be studied over many years. Such studies are now in progress in many countries and it is expected that definitive results will be forthcoming in the near future. However, just because there is no definite evidence at this stage, does not mean that there is no potential danger.”

Recommendations to reduce Exposure: [CANSA has issued a Fact Sheet and Position Statement on Exposure to Radiofrequency Electromagnetic Fields](#)

“CANSA proposes that exposure to cell phone radiation be kept to a minimum by:
Limiting the number and duration of calls Texting rather than making calls Switching the sides of the head when a call is long – one should, however, avoid long conversations
Making use of hands-free kits or speaker phone mode to keep the phone a distance from the head. Instructing children and teenagers to limit calls to emergencies only as they are more vulnerable to electro-magnetic radiation because of the thickness of their skulls and their brains are still developing Not sleeping with one’s cell phone close to one’s bed or under one’s pillow Women not to keep their cell phones in their brassiere Men not to carry their cell phones in the pockets of their pants (close to their testicles).”

The Canadian Medical Association

2011 Resolution on Cell Phone Radiation

“The Canadian Medical Association will educate and advise the profession and the public on methods of cellphone operation that will minimize radio frequency penetration to the brain.”

[Read the 2011 General Council of the Canadian Medical Association Proceedings \(page 54\)](#)

Canadian Medical Association Journal reports Health Canada's wireless limits are "A Disaster to Public Health" [Read the article here.](#)

Canadian Doctors

[2014 Letter by 55 Canadian Doctors](#)

The Doctors wrote Health Canada calling for more protective limits stating, *“There is considerable evidence and research from various scientific experts that exposure to microwave radiation from wireless devices; Wi-Fi, smart meters and cell towers can have an adverse*

Environmental Health Trust <http://ehtrust.org/>

impact on human physiological function”.

International Group in Support of Safer Standards for Canadians

[53 Doctors sign a Scientific Declaration on Health Canada EMF Limits July 9, 2014](#)

The Russian National Committee on Non-Ionizing Radiation Protection

[ELECTROMAGNETIC FIELDS FROM MOBILE PHONES: HEALTH EFFECT ON CHILDREN AND TEENAGERS \(2011\)](#) warns about electromagnetic radiation impacts on children and recommended WiFi not be used in schools.

- **Official Recommendations:** Those under the age of 18 should not use a mobile phone at all, recommends low- emission phones; and requires the following: on-device labelling notifying users that it is a source of RF-EMF, user guide information advising that “it is a source of harmful RF-EMF exposure” and the inclusion of courses in schools regarding mobile phones use and RF-EMF exposure issues. “Thus, for the first time in the human history, children using mobile telecommunications along with the adult population are included into the health risk group due to the RF EMF exposure.”
 - “In children, the amount of so-called stem cells is larger than in adults and the stem cells were shown to be the most sensitive to RF EMF exposure.”
 - “It is reasonable to set limits on mobile telecommunications use by children and adolescents, including ban on all types of advertisement of mobile telecommunications for children.”

[Decision of Russian National Committee on Non-Ionizing Radiation Protection](#) 2008, "Children and Mobile Phones: The Health of the Following Generations is in Danger"

The Cyprus National Committee on Environment and Child Health

This Health Committee was created by the Cyprus government to advise on children's environmental health issues and is comprised of pediatricians. They have issued strong recommendations to reduce exposure to children.

- [Protecting children from radiation emitted by Wi-Fi, mobile phones and wireless](#) by Dr. Stella Kanna Michailidou of the National Committee Chairman "Environment and Children's Health"
- [See the Commission's EMF brochure](#) on reducing the risks to children from exposure to the Non Ionizing Radiation (mobile phones, Wi-Fi, tablets, etc.).
- The Cyprus National Committee on Environment and Child Health created [a short PSA for citizens](#) about children and wireless radiation and how to reduce Wi-Fi exposure.

The Italian Society for Preventive and Social Pediatrics

The Society has officially called to prohibit cell phones for children under 10 years old.

“We do not know all the consequences associated with cell phone use, but excessive use could lead to concentration and memory loss, increase in aggressiveness and sleep disturbances,” stated Giuseppe Di Mauro, President of [The Italian Society for Preventive and Social Pediatrics](#) stating, “The damage to health are increasingly evident.”

-Read the News Article [Pediatricians Sound Alarm for Kids on Cell Phones](#)

European Academy for Environmental Medicine

2016 EMF Guidelines were published giving an overview of the current knowledge regarding EMF-related health risks and provides recommendations for the diagnosis, treatment and accessibility measures of EHS to improve and restore individual health outcomes as well as for the development of strategies for prevention.

- Read the [EUROPAEM EMF Guideline 2016 for the prevention, diagnosis and treatment of EMF-related health problems and illnesses](#)

British Medical Doctors

In 2014 a group of **British Medical Doctors** issued [Health and safety of Wi-Fi and mobile phones](#):

"We wish to highlight our concern over the safety of exposure to microwave radiation from wireless technology, particularly for vulnerable groups like children, pregnant women, the elderly and those with compromised health".

U. S. President's Cancer Panel, 2009

The 2009 U.S. President's Cancer Panel pointed to cell phones and other wireless technologies as potential causes of cancer. In its recommendations, the panel stated:

"Several steps can be taken to reduce personal exposure to RF fields from cell phones. Landlines or text messaging should be used whenever possible. If a mobile phone must be used, a headset is preferable to holding the phone to the ear. Children should be prohibited from using mobile phones except in emergencies. Active phones should not be kept on belts or in pockets. Phones should not be kept in close proximity during sleep.

Reduction of exposure to other sources of RF can be accomplished by keeping AM, FM, television, and mobile phone towers far from homes, schools, and businesses. Wireless networks should not be used in schools; wired connections should be used instead. There should be resistance to the general trend toward making everything wireless without consideration of negative consequences."

[DR. MARTHA LINET: CELLULAR \(MOBILE\) TELEPHONE USE AND CANCER RISK](#)
[DR. DAVID CARPENTER: ELECTROMAGNETIC FIELDS AND CANCER: THE COST OF DOING NOTHING](#) Page 15

"Since latency for brain cancer from environmental exposures is thought to be 20 to 30 years, comprehensive studies looking at longer-term human exposure are needed. Participants urged that a precautionary approach be taken with respect to the use of cell phones by children, who are more susceptible than adults to radiation risks."

- [Summary of of the President's Cancer Panel 2009 January 27 Phoenix, AZ](#)

Israel Dental Association

Environmental Health Trust <http://ehtrust.org/>

Israeli Dental Association issued a recommendation to decrease exposure after their research showed links to salivary gland tumors.

“One in every five rare malignant tumors of the cheek occurs in someone under age 20. Young people should limit direct exposure of the head to microwave radiation from cell phones.” [News Article: Israeli Study Sees Link Between Oral Cancer, Cell Phones](#). [Israel Dental Association: Number of cases of parotid salivary cancer rose dramatically in past five years.](#)

The Seletun Scientific Statement

In November, 2009, a scientific panel met in Seletun, Norway, for three days of intensive discussion on existing scientific evidence and public health implications of the unprecedented global exposures to artificial electromagnetic fields (EMF). EMF exposures (static to 300 GHz) result from the use of electric power and from wireless telecommunications technologies for voice and data transmission, energy, security, military and radar use in weather and transportation. The Scientific Panel recognizes that the body of evidence on EMF requires a new approach to protection of public health; the growth and development of the fetus, and of children; and argues for strong preventative actions. New, biologically-based public exposure standards are urgently needed to protect public health worldwide.

The report and Consensus Statement, published in the journal Reviews on Environmental Health (<http://www.ncbi.nlm.nih.gov/pubmed/21268443>), [Seletun Consensus Statement](#)

Potenza Picena Resolution 2011

On April 20th, 2013 the International Congress of Potenza Picena entitled “[Radar, radiofrequency and health risk](#)” concluded that “stricter safety standards for EMF needs to be adopted by governments and public health agencies because the existing ones are obsolete and they are not based on recent literature about biological effects.” [Potenza Picena Resolution 2011](#)

Porto Alegre Resolution, Brazil

Dozens of Doctors, (primarily from Brazil) have issued recommendations

“We are deeply concerned that current uses of non-ionizing radiation for mobile phones, wireless computers and other technologies place at risk the health of children and teens, pregnant women, 2 seniors and others who are most vulnerable due to age or disability, including a health condition known as electromagnetic hypersensitivity. We strongly recommend these precautionary practices: 1. Children under the age of 16 should not use mobile phones and cordless phones, except for emergency calls;” Read more at [Porto Alegre Resolution](#)

Even as far back as 1997, dozens of Boston Doctors and Health experts signed onto a petition with concerns about Sprint's Wireless Rollout.

Environmental Health Trust <http://ehtrust.org/>

1997 Boston Physicians' and Scientists' Petition To Avert Public Exposures to Microwaves

"We the undersigned physicians and scientists call upon public health officials to intervene to halt the initiation of communication transmissions employing ground level, horizontally transmitting, pulsed microwaves in Boston."

MORE RECOMMENDATIONS TO KNOW

Consumer Reports

May 2016 Consumer Reports Recommendations in article: [Does Cell Phone Use Cause Brain Cancer? What the New Study Means For You: Groundbreaking study reveals the strongest link yet between cell phone radiation and cancer. Important advice for all consumers.](#)

- Try to keep the cell phone away from your head and body. Keeping it an arm's distance away significantly reduces exposure to the low-level radiation it emits. This is particularly important when the cellular signal is weak—when your phone has only one bar, for example—because phones may increase their power then to compensate.
- Text or video call when possible, because this allows you to hold the phone farther from your body.
- When speaking, use the speakerphone on your device or a [hands-free headset](#).
- Don't stow your phone in your pants or shirt pocket. Instead, carry it in a bag or use a belt clip.

May 2016 Consumer Reports Recommendations to Government and Industry

"The substantial questions and concerns raised by this and previous research regarding cell phones and cancer requires swift and decisive action by the government and industry.

Specifically, Consumer Reports believes that:

- The National Institutes of Health should commission another animal study using current cell phone technology to determine if it poses the same risks as found in this new study.
- The Federal Communications Commission should update its requirements for testing the effect of cell phone radiation on human heads. The agency's current test is based on the devices' possible effect on large adults, though research suggests that children's thinner skulls mean they may absorb more radiation. The FCC should develop new tests that take into account the potential increased vulnerability of children.
- The Food and Drug Administration and the FCC should determine whether the maximum specific absorption rate of 1.6 W/kg over a gram of tissue is an adequate maximum limit of radiation from cell phones.
- The Centers for Disease Control and Prevention should repost it's advice on the potential hazard of cell phone radiation and cautionary advice that was taken down in August 2014.
- Cell phone manufacturers should prominently display advice on steps that cell phone users can take to reduce exposure to cell phone radiation."

September 2015 Consumer Reports Recommendations in article [Does Cell-Phone Radiation Cause Cancer?: As the debate over cell-phone radiation heats up, consumers deserve answers to whether there's a cancer connection](#)

"We feel that the research does raise enough questions that taking some common-sense precautions when using your cell phone can make sense."

New Jersey Education Association (NJEA)

The September 2016 NJEA Review recommends staff and students "*Minimize health risks from electronic devices*" and issues these steps to reduce radiation exposure:

- *Keep devices away from the body and bedroom.*
- *Carry phones in briefcases, etc., not on the body.*
- *Put devices on desks, not laps.*
- *Hard wire all devices that connect to the internet.*
- *Hard wire all fixed devices such as printers, projectors and boards.*
- *Use hard-wired phones instead of cell or cordless phones.*
- *Text rather than call.*
- *Keep conversations short or talk in person.*
- *Put devices in airplane mode, which suspends EMF transmission by the device, thereby disabling Bluetooth, GPS, phone calls, and WiFi.*
- *Use speaker phone or ear buds instead of holding the phone next your head.*
- *Take off Bluetooth devices when not using them."*
- [Read the article on the NJEA Review here.](#) [Download a PDF of the article here.](#)

The Israeli Psoriasis Association

2016: The Israeli Psoriasis Association started selling retro headsets to reduce exposure from cell phones with the logo of the association on the headsets.



[See the link at the Israeli Psoriasis Association.](#)

National Center for Health Research

[2015: Children and cell phones: is phone radiation risky for kids?](#) Article explains what we know, what we do not know and what we can do.

"By the time we find out, many people will have been harmed if cell phones are found to be dangerous. Here are some precautionary tips on how to protect your children from the health issues that could be connected to cell phone radiation.⁹

1. Turn airplane mode on when giving a child a technology device or when a cell phone is near a pregnant abdomen, to prevent exposure to radiation.

Environmental Health Trust <http://ehtrust.org/>

2. Turn off wireless networks and devices to decrease your family's radiation exposure whenever you aren't actively using them. As an easy first step, turn your Wi-Fi router off at bedtime.
3. Decrease use of phones or wifi where wireless coverage is difficult, in order to avoid an increase in radiation exposure."

Over 17 Government Health Agencies

Health agencies of countries worldwide have issued recommendations to reduce exposure to cell phones and wireless devices because of the lack of safety data. Please see a full list of the recommendations of health agencies at

<http://ehtrust.org/policy/international-policy-actions-on-wireless/>

Seletun Consensus Statement

The report and Consensus Statement, published in the journal Reviews on Environmental Health (<http://www.ncbi.nlm.nih.gov/pubmed/21268443>) by a consortium of international scientists urges global governments to adopt significantly lower human exposure standards for electromagnetic fields. "Government actions are urgently warranted now, based on evidence of serious disruption to biological systems" Go to the webpage of the [Seletun Consensus Statement](#)

Stockach Germany Doctors

"As physicians and pharmacists, we believe that the further development of the mobile phone network is a matter of concern and appeals to politicians, scientists and health care providers, to protect the protection of life and health from all of us with due diligence and to act immediately. We strongly demand: no further expansion of mobile technology, because it involves involuntary risks with probably permanent burdens."

Read the [Stockacher Appeal](#)

Copenhagen Resolution

The Copenhagen Resolution was passed at the conference "The shadow-side of the Wireless Society" on October 9, 2010 at the Parliament building, Christiansborg, Copenhagen.

"Minimize wireless radiation exposure in public spaces occupied by vulnerable groups, like schools, day care facilities and public transport."

Read the [Copenhagen Resolution](#)

The Declaration of the Official Association of Biologists of Galician:

"It is necessary to adopt the principle of Precautionary measures as defined in Law 33/2011, General of Public Health, of the Spanish state, which identifies first and specifically and unequivocally emissions Electromagnetic are a risk to health... To monitor environmental risks and their health effects, including the presence of pollutants in the environment."

[The Declaration of the Official Association of Biologists of Galician, Spanish](#)

Benevento Resolution

“Based on our review of the science, biological effects can occur from exposures to both extremely low frequency fields (ELF EMF) and radiation frequency fields (RF EMF). Epidemiological and in vivo as well as in vitro experimental evidence demonstrates that exposure to some ELF EMF can increase cancer risk in children and induce other health problems in both children and adults.”

Read the 2006 [Benevento Resolution](#)

Doctors of Lake Constance-Upper Swabia-Allgäu (373 Physicians)

As physicians, we believe that the further development of the mobile phone network is a matter of concern and appeals to politicians, scientists and persons in charge of education and health, to protect the life and health of all of us with due diligence and to act immediately.

We urge:

1. No further development of mobile technology, because it is involuntary risks with permanent burdens.
2. Massive reduction of the limits and radio loads.
3. Enlighten the population about the health risks of electromagnetic fields (Mobile phones, cordless (DECT) phones, WLAN, bluetooth)
4. Limitations of use of mobile phones and the prohibition of DECT cordless telephones in kindergartens, schools, hospitals, senior homes, public buildings and transports, similar to the ban on smoking

Read the full 2006 [Allgäuer Appeal](#), [Read the list of Doctors](#)

European/International Medical Doctors and Experts/Civic Organizations

In Madrid, on June 2013 a group of Doctors, medical organizations, researchers and representatives of civil organizations signed a statement in support of the application of ALARA (As Low As Reasonably Achievable) AND ALATA (As Low As Technically Achievable) The [list of signatories](#) includes many medical doctors in addition to: Domingo Jiménez Beltrán, the former Executive Director of the European Environment Agency (1994-2002), Dr. Tomica Anceviski, President of the Macedonian section of International Society of Doctors for the Environment; Dr. Roberto Romizi, President and on behalf of The Italian section of International Society of Doctors for the Environment; Dr Philip Michael, on behalf of the Irish Doctors Environmental Association and as VP (Europe) International Society of Doctors for the Environment; Prof. Dr. Hanns Moshammer, on behalf of the Austrian Doctors for a Healthy Environment; Fiorella Belpoggi, Ph.D., FIATP, Director and Chief of Pathology of the Cesare Maltoni /Cancer Research Centre of the Ramazzini Institute, Dr. Morando Soffritti, M.D; Oncologist, Scientific Director of the European Foundation for Oncology and Environmental Sciences

[Read the European Manifesto in support of a European Citizens' Initiative](#) (last updated July 2016)

Environmental Health Trust <http://ehtrust.org/>

The Freiburg Appeal International Doctors' Appeal

More than 1000 physicians [signed the "Freiburg Appeal" in 2002](#). Ten years later, Doctors initiated [the Appeal in 2012](#) which is ongoing.

"More and more new wireless technologies are introduced into our daily lives: cell phone networks, TETRA, LTE, cordless phones, Wi-Fi, baby monitors, wireless meters, digital radio and TV, and many others. All of these wireless technologies interfere with the biophysical organization of life with increasing layers and densities of electromagnetic fields."

[Freiburg Appeal: Wireless Radiation Poses a Health Risk.](#)

Wuerzburg Appeal , 2010

The European Academy for Environmental Medicine (EUROPAEM) invited many renowned national and international scientists and health care professionals to a medical conference held in Wuerzburg, Germany from April 23 to April 25, 2010. This appeal was unanimously adopted by the congress.

[Read the Wuerzburg Appeal, 2010](#)

Letters by Medical Doctors to Schools on Wireless Installations in Schools**Letters to Petaluma Public Schools California, 2016**

(Note: These letters are important as they were written after the NTP study release and include an analysis of how the research impacts an understanding of the risk to children).

- [Letter from Dr. Carpenter to Petaluma Public Schools 8/3/2016](#)
- [Letter from Dr. Anthony Miller to Petaluma Public Schools 8/4/2016](#)
- [Letter from Dr. Martha Herbert to Petaluma Public Schools 9/2016](#)
- [Letter from Dr. Lennart Hardell to Petaluma Public Schools 8/4/2016](#)

Letters to Montgomery County Public Schools Maryland, 2015

- [Lennart Hardell, MD, PhD, and Michael Carlberg, MSc, Department of Oncology, Orebro University Hospital, Sweden to Montgomery County Schools](#) 11/30/2015
- [Dr. Olle Johansson, Karolinska Institute to Montgomery County Schools](#) 12/8/2015
- [Dr. Martha Herbert, Harvard Pediatric Neurologist to Montgomery County Schools](#) 12/12/2015
- [Anthony B. Miller, MD FACE, Professor Emeritus Dalla Lana School of Public Health, University of Toronto, World Health Organization Advisor to Montgomery County Schools](#)
- [Dr. David O. Carpenter, M.D. University of Albany to Montgomery County Schools](#)
- [Dr. Martin L. Pall, Professor Emeritus, Biochemistry and Basic Medical Sciences, Washington State University to Montgomery County Schools](#)
- [Devra Davis, PhD MPH, President and Founder Environmental Health Trust to Montgomery County Schools](#)

- [Mikko Ahonen, PhD, Finland, Institute of Environmental Health and Safety, Mrs. Lena Hedendahl, MD Practitioner, Luleå, Sweden, Mr. Tarmo Koppel, MSc., PhD to Montgomery County Schools December 13, 2015](#)
- [Cindy Sage, MA, Sage Associates, Co-Editor, BioInitiative 2007 and 2012 Reports and Prof. Trevor Marshall, PhD, Director, Autoimmunity Research Foundation, Senior Member IEEE, Founding chair \(retired\) IEEE EMBS \(Buenaventura Chapter\) Fellow, European Association for Predictive, Preventive and Personalised Medicine \(Brussels\) International Expert Council, Community of Practice: Preventative Medicine \(Moscow\) to Montgomery County Schools](#)
- [Dr. Ronald Powell, retired U.S. Government scientist \(Ph.D., Applied Physics, Harvard University\) to Montgomery County Schools](#)
- [Cris Rowan, BScBi, BScOT, SIPT, to Montgomery County Schools](#)
- [Lloyd Morgan, Engineer, Scientific Advisor, Environmental Health Trust to Montgomery County](#)

Letters to the Los Angeles School District

- [Olle Johansson's Letter](#) to the LAUSD
- [Dr. Martin Blank's Letter](#) to the LAUSD
- [Dr. Joel Moskowitz Letter](#) to the LAUSD
- [Dr. Blanks Letter on Cell Towers near Schools.](#)
- [A Compilation of Letters by Doctors at Dr. Moskowitz website](#) UC Berkeley

Letters by Experts

- [Ron Powell, PhD Message to Public Schools about Wireless Devices, 2016](#)
- [Ron Powell PhD, The Health Argument against Cell Phones and Cell Towers, 2016](#)
- [Bioinitiative Letter to Education Super Highway CEOs](#)
 - This letter was written by Cindy Sage and David Carpenter, Co-Editors of the Bioinitiative Report to the CEO's on wireless infrastructure in US schools.
- [The American Academy of Environmental Medicine's Open Letter to the Superintendents of the School Districts of the United States](#)
- [Irish Doctors Environmental Association 2013 Letter Recommending Wired Connections](#)
- Cris Rowan, [Open Letter to the Canadian Council of Education Ministers asking for removal of wireless radiation from school environments](#)
- [Frank Clegg' Letter](#) to Denmark's Committee on Radiation Protection
- [Dr. David Carpenter's Letter](#) to Kawartha Pine Ridge District School Board, 2011
- [Dr. Steven Sinatra Letter to the Kawartha School Board, 2011](#)
- [2009 Dr. Magda Havas' Open Letter: Open Letter to Parents, Teachers, & School Boards Regarding Wi-Fi Networks in Schools and Cell Phone Antennas near School Property](#)
- [British Medical Doctor's Letter Health and safety of Wi-Fi and mobile phones](#)
- [Olle Johansson, PhD Letter on WiFi in Schools Australia, 2013](#)

Q: Why do federal regulations allow cell phones to be sold to children if Doctors are so concerned?

A: As history shows, federal protections are usually implemented **decades after** research shows an environmental exposure is harmful. In the United States, for example, the American Academy of Pediatrics recommends reducing exposure to cell phones *and at the same time*, the federal government's FCC - lead by a former Chief of the Wireless Industry- is rolling out more and more wireless infrastructure. Not a single US federal health agency has done a systematic research review on the issue and -as far as we know- there are currently no plans to do so. Therefore, it is important for people to be made aware of these issues and take precautions *now*- in their homes, work, school and community.

Organizations; Council of Europe, Résolution 1815, The Potential Dangers of
Electromagnetic Fields and Their Effect on the Environment; 2011

<http://assembly.coe.int>COUNCIL
OF EUROPECONSEIL
DE L'EUROPE

Résolution 1815

27 May 2011

The potential dangers of electromagnetic fields and their effect on the environment

Text adopted by the Standing Committee, acting on behalf of the Assembly, on 27 May 2011 (see [Doc. 12608](#), report of the Committee on the Environment, Agriculture and Local and Regional Affairs, rapporteur: Mr Huss).

1. The Parliamentary Assembly has repeatedly stressed the importance of states' commitment to preserving the environment and environmental health, as set out in many charters, conventions, declarations and protocols since the United Nations Conference on the Human Environment and the Stockholm Declaration (Stockholm, 1972). The Assembly refers to its past work in this field, namely [Recommendation 1863](#) (2009) on environment and health, [Recommendation 1947](#) (2010) on noise and light pollution, and more generally, [Recommendation 1885](#) (2009) on drafting an additional protocol to the European Convention on Human Rights concerning the right to a healthy environment and [Recommendation 1430](#) (1999) on access to information, public participation in environmental decision-making and access to justice – implementation of the Aarhus Convention.
2. The potential health effects of the very low frequency of electromagnetic fields surrounding power lines and electrical devices are the subject of ongoing research and a significant amount of public debate. According to the World Health Organisation, electromagnetic fields of all frequencies represent one of the most common and fastest growing environmental influences, about which anxiety and speculation are spreading. All populations are now exposed to varying degrees of to electromagnetic fields, the levels of which will continue to increase as technology advances.
3. Mobile telephony has become commonplace around the world. This wireless technology relies upon an extensive network of fixed antennas, or base stations, relaying information with radio frequency signals. Over 1.4 million base stations exist worldwide and the number is increasing significantly with the introduction of third generation technology. Other wireless networks that allow high-speed internet access and services, such as wireless local area networks, are also increasingly common in homes, offices and many public areas (airports, schools, residential and urban areas). As the number of base stations and local wireless networks increases, so does the radio frequency exposure of the population.
4. While electrical and electromagnetic fields in certain frequency bands have wholly beneficial effects which are applied in medicine, other non-ionising frequencies, be they sourced from extremely low frequencies, power lines or certain high frequency waves used in the fields of radar, telecommunications and mobile telephony, appear to have more or less potentially harmful, non-thermal, biological effects on plants, insects and animals as well as the human body even when exposed to levels that are below the official threshold values.

5. As regards standards or threshold values for emissions of electromagnetic fields of all types and frequencies, the Assembly recommends that the ALARA or “as low as reasonably achievable” principle is applied, covering both the so-called thermal effects and the athermic or biological effects of electromagnetic emissions or radiation. Moreover, the precautionary principle should be applicable when scientific evaluation does not allow the risk to be determined with sufficient certainty, especially given the context of growing exposure of the population, including particularly vulnerable groups such as young people and children, which could lead to extremely high human and economic costs of inaction if early warnings are neglected.

6. The Assembly regrets that, despite calls for the respect of the precautionary principle and despite all the recommendations, declarations and a number of statutory and legislative advances, there is still a lack of reaction to known or emerging environmental and health risks and virtually systematic delays in adopting and implementing effective preventive measures. Waiting for high levels of scientific and clinical proof before taking action to prevent well-known risks can lead to very high health and economic costs, as was the case with asbestos, leaded petrol and tobacco.

7. Moreover, the Assembly notes that the problem of electromagnetic fields or waves and the potential consequences for the environment and health has clear parallels with other current issues, such as the licensing of medication, chemicals, pesticides, heavy metals or genetically modified organisms. It therefore highlights that the issue of independence and credibility of scientific expertise is crucial to accomplish a transparent and balanced assessment of potential negative impacts on the environment and human health.

8. In light of the above considerations, the Assembly recommends that the member states of the Council of Europe:

8.1. in general terms:

8.1.1. take all reasonable measures to reduce exposure to electromagnetic fields, especially to radio frequencies from mobile phones, and particularly the exposure to children and young people who seem to be most at risk from head tumours;

8.1.2. reconsider the scientific basis for the present electromagnetic fields exposure standards set by the International Commission on Non-Ionising Radiation Protection, which have serious limitations and apply “as low as reasonably achievable” (ALARA) principles, covering both thermal effects and the athermic or biological effects of electromagnetic emissions or radiation;

8.1.3. put in place information and awareness-raising campaigns on the risks of potentially harmful long-term biological effects on the environment and on human health, especially targeting children, teenagers and young people of reproductive age;

8.1.4. pay particular attention to “electrosensitive” persons suffering from a syndrome of intolerance to electromagnetic fields and introduce special measures to protect them, including the creation of wave-free areas not covered by the wireless network;

8.1.5. in order to reduce costs, save energy, and protect the environment and human health, step up research on new types of antennas and mobile phone and DECT-type devices, and encourage research to develop telecommunication based on other technologies which are just as efficient but have less negative effects on the environment and health;

8.2. concerning the private use of mobile phones, DECT phones, WiFi, WLAN and WIMAX for computers and other wireless devices such as baby phones:

8.2.1. set preventive thresholds for levels of long-term exposure to microwaves in all indoor areas, in accordance with the precautionary principle, not exceeding 0.6 volts per metre, and in the medium term to reduce it to 0.2 volts per metre;

8.2.2. undertake appropriate risk-assessment procedures for all new types of device prior to licensing;

8.2.3. introduce clear labelling indicating the presence of microwaves or electromagnetic fields, the transmitting power or the specific absorption rate (SAR) of the device and any health risks connected with its use;

8.2.4. raise awareness on potential health risks of DECT-type wireless telephones, baby monitors and other domestic appliances which emit continuous pulse waves, if all electrical equipment is left permanently on standby, and recommend the use of wired, fixed telephones at home or, failing that, models which do not permanently emit pulse waves;

8.3. concerning the protection of children:

8.3.1. develop within different ministries (education, environment and health) targeted information campaigns aimed at teachers, parents and children to alert them to the specific risks of early, ill-considered and prolonged use of mobiles and other devices emitting microwaves;

8.3.2. for children in general, and particularly in schools and classrooms, give preference to wired Internet connections, and strictly regulate the use of mobile phones by schoolchildren on school premises;

8.4. concerning the planning of electric power lines and relay antenna base stations:

8.4.1. introduce town planning measures to keep high-voltage power lines and other electric installations at a safe distance from dwellings;

8.4.2. apply strict safety standards for sound electric systems in new dwellings;

8.4.3. reduce threshold values for relay antennas in accordance with the ALARA principle and install systems for comprehensive and continuous monitoring of all antennas;

8.4.4. determine the sites of any new GSM, UMTS, WiFi or WIMAX antennas not solely according to the operators' interests but in consultation with local and regional government officials, local residents and associations of concerned citizens;

8.5. concerning risk assessment and precautions:

8.5.1. make risk assessment more prevention oriented;

8.5.2. improve risk-assessment standards and quality by creating a standard risk scale, making the indication of the risk level mandatory, commissioning several risk hypotheses and considering compatibility with real life conditions;

8.5.3. pay heed to and protect "early warning" scientists;

8.5.4. formulate a human rights oriented definition of the precautionary and ALARA principles;

8.5.5. increase public funding of independent research, *inter alia* through grants from industry and taxation of products which are the subject of public research studies to evaluate health risks;

8.5.6. create independent commissions for the allocation of public funds;

8.5.7. make the transparency of lobby groups mandatory;

8.5.8. promote pluralist and contradictory debates between all stakeholders, including civil society (Aarhus Convention).

Organizations; Council of Europe, Parliamentary Assembly Report:
The potential dangers of electromagnetic fields and their effect
on the environment; 2011



Doc. 12608

6 May 2011

The potential dangers of electromagnetic fields and their effect on the environment

Report¹

Committee on the Environment, Agriculture and Local and Regional Affairs

Rapporteur: Mr Jean HUSS, Luxembourg, Socialist Group

Summary

The potential health effects of the very low frequency of electromagnetic fields surrounding power lines and electrical devices are the subject of ongoing research and a significant amount of public debate. While electrical and electromagnetic fields in certain frequency bands have fully beneficial effects which are applied in medicine, other non-ionising frequencies, be they sourced from extremely low frequencies, power lines or certain high frequency waves used in the fields of radar, telecommunications and mobile telephony, appear to have more or less potentially harmful, non-thermal, biological effects on plants, insects and animals, as well as the human body when exposed to levels that are below the official threshold values.

One must respect the precautionary principle and revise the current threshold values; waiting for high levels of scientific and clinical proof can lead to very high health and economic costs, as was the case in the past with asbestos, leaded petrol and tobacco.

¹ Reference to the committee: Doc. 11894, Reference 3563 of 29 May 2009.

A. Draft resolution²

1. The Parliamentary Assembly has repeatedly stressed the importance of states' commitment to preserving the environment and environmental health, as set out in many charters, conventions, declarations and protocols since the United Nations Conference on the Human Environment and the Stockholm Declaration (Stockholm, 1972). The Assembly refers to its past work in this field, namely Recommendation 1863 (2009) on environment and health, Recommendation 1947 (2010) on noise and light pollution, and more generally, Recommendation 1885 (2009) on drafting an additional protocol to the European Convention on Human Rights concerning the right to a healthy environment and Recommendation 1430 (1999) on access to information, public participation in environmental decision-making and access to justice – implementation of the Aarhus Convention.
2. The potential health effects of the very low frequency of electromagnetic fields surrounding power lines and electrical devices are the subject of ongoing research and a significant amount of public debate. According to the World Health Organisation, electromagnetic fields of all frequencies represent one of the most common and fastest growing environmental influences, about which anxiety and speculation are spreading. All populations are now exposed to varying degrees of to electromagnetic fields, the levels of which will continue to increase as technology advances.
3. Mobile telephony has become commonplace around the world. This wireless technology relies upon an extensive network of fixed antennas, or base stations, relaying information with radio frequency signals. Over 1.4 million base stations exist worldwide and the number is increasing significantly with the introduction of third generation technology. Other wireless networks that allow high-speed internet access and services, such as wireless local area networks, are also increasingly common in homes, offices and many public areas (airports, schools, residential and urban areas). As the number of base stations and local wireless networks increases, so does the radio frequency exposure of the population.
4. While electrical and electromagnetic fields in certain frequency bands have wholly beneficial effects which are applied in medicine, other non-ionising frequencies, be they sourced from extremely low frequencies, power lines or certain high frequency waves used in the fields of radar, telecommunications and mobile telephony, appear to have more or less potentially harmful, non-thermal, biological effects on plants, insects and animals as well as the human body even when exposed to levels that are below the official threshold values.
5. As regards standards or threshold values for emissions of electromagnetic fields of all types and frequencies, the Assembly recommends that the ALARA or "as low as reasonably achievable" principle is applied, covering both the so-called thermal effects and the athermic or biological effects of electromagnetic emissions or radiation. Moreover, the precautionary principle should be applicable when scientific evaluation does not allow the risk to be determined with sufficient certainty, especially given the context of growing exposure of the population, including particularly vulnerable groups such as young people and children, which could lead to extremely high human and economic costs of inaction if early warnings are neglected.
6. The Assembly regrets that, despite calls for the respect of the precautionary principle and despite all the recommendations, declarations and a number of statutory and legislative advances, there is still a lack of reaction to known or emerging environmental and health risks and virtually systematic delays in adopting and implementing effective preventive measures. Waiting for high levels of scientific and clinical proof before taking action to prevent well-known risks can lead to very high health and economic costs, as was the case with asbestos, leaded petrol and tobacco.
7. Moreover, the Assembly notes that the problem of electromagnetic fields or waves and the potential consequences for the environment and health has clear parallels with other current issues, such as the licensing of medication, chemicals, pesticides, heavy metals or genetically modified organisms. It therefore highlights that the issue of independence and credibility of scientific expertise is crucial to accomplish a transparent and balanced assessment of potential negative impacts on the environment and human health.
8. In light of the above considerations, the Assembly recommends that the member states of the Council of Europe:

8.1. in general terms:

² Draft resolution adopted unanimously by the committee on 11 April 2011.

- 8.1.1. take all reasonable measures to reduce exposure to electromagnetic fields, especially to radio frequencies from mobile phones, and particularly the exposure to children and young people who seem to be most at risk from head tumours;
- 8.1.2. reconsider the scientific basis for the present electromagnetic fields exposure standards set by the International Commission on Non-Ionising Radiation Protection, which have serious limitations and apply "as low as reasonably achievable" (ALARA) principles, covering both thermal effects and the athermic or biological effects of electromagnetic emissions or radiation;
- 8.1.3. put in place information and awareness-raising campaigns on the risks of potentially harmful long-term biological effects on the environment and on human health, especially targeting children, teenagers and young people of reproductive age;
- 8.1.4. pay particular attention to "electrosensitive" persons suffering from a syndrome of intolerance to electromagnetic fields and introduce special measures to protect them, including the creation of wave-free areas not covered by the wireless network;
- 8.1.5. in order to reduce costs, save energy, and protect the environment and human health, step up research on new types of antennas and mobile phone and DECT-type devices, and encourage research to develop telecommunication based on other technologies which are just as efficient but have less negative effects on the environment and health;
- 8.2. concerning the private use of mobile phones, DECT phones, WiFi, WLAN and WIMAX for computers and other wireless devices such as baby phones:
 - 8.2.1. set preventive thresholds for levels of long-term exposure to microwaves in all indoor areas, in accordance with the precautionary principle, not exceeding 0.6 volts per metre, and in the medium term to reduce it to 0.2 volts per metre;
 - 8.2.2. undertake appropriate risk-assessment procedures for all new types of device prior to licensing;
 - 8.2.3. introduce clear labelling indicating the presence of microwaves or electromagnetic fields, the transmitting power or the specific absorption rate (SAR) of the device and any health risks connected with its use;
 - 8.2.4. raise awareness on potential health risks of DECT-type wireless telephones, baby monitors and other domestic appliances which emit continuous pulse waves, if all electrical equipment is left permanently on standby, and recommend the use of wired, fixed telephones at home or, failing that, models which do not permanently emit pulse waves;
- 8.3. concerning the protection of children:
 - 8.3.1. develop within different ministries (education, environment and health) targeted information campaigns aimed at teachers, parents and children to alert them to the specific risks of early, ill-considered and prolonged use of mobiles and other devices emitting microwaves;
 - 8.3.2. ban all mobile phones, DECT phones or WiFi or WLAN systems from classrooms and schools, as advocated by some regional authorities, medical associations and civil society organisations;
- 8.4. concerning the planning of electric power lines and relay antenna base stations:
 - 8.4.1. introduce town planning measures to keep high-voltage power lines and other electric installations at a safe distance from dwellings;
 - 8.4.2. apply strict safety standards for sound electric systems in new dwellings;
 - 8.4.3. reduce threshold values for relay antennas in accordance with the ALARA principle and install systems for comprehensive and continuous monitoring of all antennas;

8.4.4. determine the sites of any new GSM, UMTS, WiFi or WIMAX antennas not solely according to the operators' interests but in consultation with local and regional government officials, local residents and associations of concerned citizens;

8.5. concerning risk assessment and precautions:

8.5.1. make risk assessment more prevention oriented;

8.5.2. improve risk-assessment standards and quality by creating a standard risk scale, making the indication of the risk level mandatory, commissioning several risk hypotheses and considering compatibility with real life conditions;

8.5.3. pay heed to and protect "early warning" scientists;

8.5.4. formulate a human rights oriented definition of the precautionary and ALARA principles;

8.5.5. increase public funding of independent research, *inter alia* through grants from industry and taxation of products which are the subject of public research studies to evaluate health risks;

8.5.6. create independent commissions for the allocation of public funds;

8.5.7. make the transparency of lobby groups mandatory;

8.5.8. promote pluralist and contradictory debates between all stakeholders, including civil society (Aarhus Convention).

B. Explanatory memorandum by Mr Huss, rapporteur**Contents**

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1. Introduction

1. Electromagnetic fields, whether emitted by high-voltage lines, domestic appliances, relay antennas, mobile telephones or other microwave devices, are increasingly present in our techno-industrial environment.

2. Obviously, in evolutionary terms, living or working in artificial electromagnetic extremely low frequency and high frequency fields, on top of the electromagnetic fields naturally occurring in the environment, is still a relatively new experience for human beings, fauna and flora. It goes back no further than fifty years or so, when intensive industrial and domestic exposure began with radars, radio waves and televisions and electromagnetic fields generated by high-voltage lines and household electrical appliances.

3. It was only from the 1990s onwards that the new telephony and wireless mobile communication technologies began to boom ever faster Europe-wide and even worldwide thanks to increasingly diverse and sophisticated applications: mobile telephones, cordless telephones, WiFi, WLAN (wireless local area network), etc.

4. The term "electromagnetic fields" covers all the fields emitted by natural and man-made sources. A distinction is drawn between static fields and alternating fields. In the latter case there is essentially a differentiation between extremely low frequency (ELF) fields, such as domestic electricity, and hyper-frequency (HF) fields, which include mobile telephones. Electrical fields are measured in volts per metre (v/m), whereas magnetic fields are measured in terms of current-induced exposure in microteslas (μ t). Since very weak electrical currents are part of human physiology, at the level of communication between cells for example, the question of the possible disruptive effects of present levels of artificial exposure on the human environment and any consequences they might have for health may legitimately be raised.

5. It should be noted with satisfaction that a major contribution was made by the technological innovations resulting from electrification and new radio-telecommunication techniques to economic growth and the material well-being of the populations of industrialised countries. Domestic appliances, for example, have greatly helped to lighten the load from everyday chores in millions of households and played a not inconsiderable role in the women's liberation movement.

2. Background to the debate

6. Nevertheless, it must be said that, since some of these new technologies were first introduced, environmental or health problems have emerged and become a topic of discussion in certain countries, both in scientific circles and in the field of health and occupational medicine. From the 1930s onwards, radar waves were linked to certain "microwave syndromes" among operators and technicians subjected to intensive and prolonged exposure. The former USSR and Eastern bloc countries adopted very low preventive thresholds aimed at protecting operators' health.

7. In the United States and western Europe, discussion of potential harm to health resulting from electromagnetic fields focused, in the 1970s and 1980s, essentially on the problem of high- or very high-voltage lines and protection in the workplace (for those working on computers, in electrically powered steelworks, etc). As far as the risks from high-voltage lines are concerned, an American epidemiological study (Wertheimer and Leeper, 1979) demonstrated a link between the proximity of high-voltage lines and

child leukaemia, corroborated in 2001 by the International Agency for Research on Cancer (IARC), which classified these fields as "possibly carcinogenic to humans" (category 2B). At the same time, from the early 1980s onwards, another issue relating to electromagnetic fields and chemical pollution was raised at international conferences: discomforts due to office computer screens, health effects in the form of headaches, fatigue and eye and skin problems. Regarding the electromagnetic aspect of those effects, stringent preventive standards (TCO standards) were proposed at the beginning of the 1990s by the Swedish Confederation of Employees and then widely adopted.

8. The 1990s saw a boom in mobile telephony and its rapid expansion, first in the industrialised countries and then increasingly in the developing countries of Africa, Asia and Latin America.

9. Mobile telephony and ever more sophisticated wireless telecommunication applications have not only been taken on board in professional spheres but have also quite literally invaded our private life. This affects even very young children, at home, at school, on transport, etc.

3. Growing concerns in Europe

10. However, for a good ten years or so, Europe's populations have begun to show increasing concern over the potential health risks of mobile telephony, with reliable information on these questions in short supply. In a recent Eurobarometer study (European Commission), 48% of Europeans stated that they were concerned or very concerned over the potential health risks posed by mobile telephony. The presumption of risk was noted among 76% of Europeans concerning relay antennas and 73% concerning the potential effects of mobile telephones respectively.

11. Such concerns over electromagnetic fields or waves have triggered the emergence and growth of a multitude of citizens' initiatives in many countries. These initiatives are mostly directed against the installation of relay antenna stations, above all close to schools, nurseries, hospitals or other institutions caring for children or vulnerable individuals, and also increasingly challenge other aspects of wireless telecommunication such as WiFi in schools for example.

12. The Committee on the Environment, Agriculture and Local and Regional Affairs organised two hearings with experts on 17 September 2010 and 25 February 2011.

13. At the first hearing of experts, Mr Ralph Baden of the Occupational Medicine Department of the Ministry of Health of the Grand-Duchy of Luxembourg spoke generally about the issue of very low frequency and high frequency electromagnetic fields and waves and the respective applicable threshold values. He listed the different sources of those electromagnetic fields outside dwellings: relay antennas, high-voltage lines, radio stations, television, radars, etc, but laid special emphasis on the results of measurement readings, on sources of such fields in homes or public buildings and provided concrete examples of simple and practical means of reducing exposure to these "indoor" fields and eliminating certain health problems, such as headaches, insomnia, coughs, depression, etc.

4. Effects on the environment: plants, insects, animals

14. At the same hearing of experts, Dr Ulrich Warnke of the Institute of Technical Biology and Bionics in Saarbrücken described the biological effects of certain microwave frequencies on plants. Depending on the frequencies, their intensity and modulation and the length of exposure, scientific studies demonstrated stress reactions and disruptions of gene expression. Recent studies by the cellular biology laboratory of Clermont-Ferrand University (2007), for example, clearly show the effects of mobile telephony microwaves on plant genes, in particular tomato plants.

15. Other scientific international studies show comparable stress reactions in certain types of beans, as well as deciduous and coniferous trees exposed to various frequencies (relay antennas, TETRA frequency).

16. Dr Warnke highlighted the innate magnetic compass used by certain animals or insects to orient themselves in time and space and which dictates the internal functioning of their organism, before going on to demonstrate how extremely weak artificial fields or waves could adversely affect the sense of direction, navigation and communication of certain animals or insects: migratory birds, pigeons, certain kinds of fish (sharks, whales, rays) or certain insects (ants, butterflies and especially bees). He suggested that malfunctions induced by artificial electromagnetic waves might be one of the major causes – besides problems of exposure to chemicals – of repeated incidents of whales being washed up on beaches or the death or disappearance of bee colonies (colony collapse disorder) observed in past years.

17. The great multitude of scientific studies quoted during the hearing of experts should certainly prompt policymakers to reflect on their decisions and act accordingly. One final aspect mentioned during the hearing concerned the potentially pathogenic effects observed in livestock – calves, cows, horses, geese, etc. – following the installation of mobile telephone masts nearby: unaccountable deformities of new-born calves, cataracts, fertility problems.

18. In the face of fast-growing concerns and opposition in many Council of Europe member states, the response of top executives of electricity companies and mobile telephone operators is to deny that their industrial and commercial activities have any adverse effect on human health. At the hearing in Paris on 25 February 2011, the official representatives of French and European mobile telephone operators passionately argued that the official threshold values applicable in most countries in the world were adequate to protect human beings from the thermal effects of mobile telephones and that any biological effects, if these could be demonstrated, would not have any adverse effects on human health.

19. To back up their argument, the experts quoted the scientific assessments carried out by associations such as the International Committee on Non-Ionisation Radiation Protection (ICNIRP), a small private NGO near Munich, or by official organisations: the World Health Organization, the European Commission and a number of national protection agencies. It appears that these European and national organisations or international bodies have based their thinking on the threshold values and recommendations advocated by the ICNIRP when that private association was set up near Munich at the beginning of the 1990s.

20. Yet, at the same hearing, leaders of associations of citizens and representatives of the NGOs such as "Robin des toits", laid heavy emphasis on the numerous risks and harmful biological effects and related health problems which they believed to be linked to electromagnetic fields or waves from mobile telephony, relay antennas, high-voltage lines and other artificially generated electromagnetic fields, even at very low levels that were well below the officially applicable threshold values.

21. The representative of the European Environment Agency in Copenhagen, an official advisory body to the European Union, stressed the importance of the precautionary principle written into the European treaties and accordingly pointed to the need for effective preventive measures to protect human health and avoid painful health issues or scandals of the kind already experienced over asbestos, tobacco smoking, lead and PCBs (polychlorobiphenyls), to name but a few. He presented a convincing analysis of the scientific assessment methods currently used and the different levels of evidence to conclude, on the basis of the "Bioinitiative" scientific report and other more recent studies by the Ramazzini Institute in Bologna, that the indices or levels of proof were sufficient at this stage to prompt action by governments and international bodies.

22. Finally, another expert specialising in clinical medicine and oncology confirmed, on the basis of the findings of biological and clinical analysis of several hundred French patients describing themselves as "electrosensitive", that a syndrome of intolerance to electromagnetic fields (SIEMF) does exist and that those people are not feigning illness or suffering from psychiatric disorders.

5. Biological effects of electromagnetic fields in medicine

23. It has been established since the beginning of the 20th century that electromagnetic fields operating at various frequencies can have useful and beneficial effects in clinical medicine, whether for diagnosis or treatment.

24. Scientific developments since the Second World War have revealed that the human organism does not function solely on the basis of biological or biochemical cellular reactions but that humans are also electromagnetic beings. It is now well known that nerve cells communicate between one another using electrical impulses. The most powerful electrical signals detected in humans are those generated by nervous and muscular activity. In the case of the heart, which is the most important muscle group in the body, cardiac functioning is medically diagnosed by recording the electrical signals emitted by it (electrocardiogram – ECG). Again at the level of diagnosis, electroencephalography (EEG) allows non-invasive monitoring of the brain's electrical activity. The EEG has been widely used in the clinical areas of brain disorders, sleep pattern monitoring or confirmation of clinical death.

6. Therapeutic use of electric currents or electromagnetic waves

25. Without going into detail, the rapporteur wishes to point out that certain electrical currents or electromagnetic waves used at certain frequencies may have a perfectly beneficial effect in medical terms. There are a number of examples illustrating the therapeutic benefits of electrotherapy: clinical effects of

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direct electric currents (electrolysis), clinical effects of external electrical impulses on the cardiac muscle (defibrillators, pacemakers), clinical effects of micro-currents generated by pulsed magnetic fields to improve healing in tissue repair and bone fractures, to mention only the best known of these non-ionising frequency band applications.

26. But while electrical and electromagnetic fields in certain frequency bands have fully beneficial effects, other non-ionising frequencies, be they sourced from extremely low frequencies, power lines or certain high frequency waves used in the fields of radar, telecommunications and mobile telephony, appear to have more or less potentially harmful biological effects on plants, insects and animals as well as the human body even when exposed to levels that are below the official threshold values.

7. Technological progress and economic growth at the expense of environment and health protection

27. It should be noted that the problem of electromagnetic fields or waves and the potential consequences for the environment and health has clear parallels with other current issues, such as the licensing of chemicals, pesticides, heavy metals or genetically modified organisms (GMOs), to mention only the best known examples. It is certain that one cause of public anxiety and mistrust of the communication efforts of official safety agencies and governments lies in the fact that a number of past health crises or scandals, such those involving asbestos, contaminated blood, PCBs or dioxins, lead, tobacco smoking and more recently H1N1 flu were able to happen despite the work or even with the complicity of national or international agencies nominally responsible for environmental or health safety.

28. Indeed, it is in this connection that the Committee on the Environment, Agriculture and Local and Regional Affairs is currently working on the question of conflicts of interest and the urgent need for real independence of scientists involved in the official agencies tasked with evaluating the risks of products prior to licensing.

29. The rapporteur underlines in this context that it is most curious, to say the least, that the applicable official threshold values for limiting the health impact of extremely low frequency electromagnetic fields and high frequency waves were drawn up and proposed to international political institutions (WHO, European Commission, governments) by the ICNIRP, an NGO whose origin and structure are none too clear and which is furthermore suspected of having rather close links with the industries whose expansion is shaped by recommendations for maximum threshold values for the different frequencies of electromagnetic fields.

30. If most governments and safety agencies have merely contented themselves with replicating and adopting the safety recommendations advocated by the ICNIRP, this has essentially been for two reasons:

- in order not to impede the expansion of these new technologies with their promise of economic growth, technological progress and job creation;
- and also because the political decision-makers unfortunately still have little involvement in matters of assessing technological risks for the environment and health.

31. With regard to the frequently inconclusive if not contradictory findings of scientific research and studies on the possible risks of products, medicines or, in this case, electromagnetic fields, a number of comparative studies do seem to suggest a fairly strong correlation between the origin of their funding – private or public – and the findings of risk assessments, a manifestly unacceptable situation pointing to conflicts of interest which undermine the integrity, the genuine independence and the objectivity of scientific research.

32. Concerning the assessment of health risks resulting from mobile telephone radio frequencies, for example, in 2006 Swiss researchers from Bern University presented the findings of a systematic analysis of all research results and concluded that there was a strong correlation between how the research was funded and the results obtained: 33% of studies funded by industrial concerns conclude that exposure to mobile telephone radio frequencies has an effect on our organism. That figure rises to over 80% in studies carried out with public funding.

33. Accordingly, in this field and in others, one should call for genuine independence on the part of the expert appraisal agencies and for independent, multidisciplinary and properly balanced expert input. There must no longer be situations where whistleblowers are discriminated against and renowned scientists with critical opinions are excluded when experts are selected to sit on expert committees or no longer receive funding for their research.

8. Contending forces and arguments: the dispute over the incidence of biological effects and over threshold values

34. It seems obvious that the prime considerations for societies dependent on electricity, mobile telephony and telecommunication are the economic and financial parameters, hence profits and market shares. Understandably, in this context more stringent regulations and threshold values which ostensibly inhibit their business dealings are viewed with disfavour and forcefully resisted – as could be seen from the irritated and sometimes emotional statements of a representative of French mobile telephony at our committee's hearing for contrastive expert opinion.

35. The representatives of mobile telephony have for years espoused the same paradigm and the same line of argument, in which they invoke the soothing discourse of most international agencies and institutions. For example, the threshold values of 100 microtesla for low or very low frequency electromagnetic fields and 41/42 volts/metre for the very high frequencies of mobile telephony on 900 megahertz (MHz) are claimed to be quite adequate for protecting the public against thermal effects. At very high levels, the radio frequency fields are plainly liable to produce harmful thermal effects on the human body, in the estimation of all parties moreover.

36. Of course there remains the very vexed question whether there are non-thermal or athermic, hence biological, consequences for the environment and the human body. The operators' representatives totally deny the existence of nefarious long-term biological effects for electromagnetic fields below the threshold values in force. To illustrate the nature and extent of these threshold values, let us mention by way of an example Article 5.1 of Directive 2004/40/EC of the European Parliament and of the Council of 29 April 2004 concerning the minimum standards for protecting workers: "... However, the long-term effects, including possible carcinogenic effects due to exposure to time-varying electric, magnetic and electromagnetic fields for which there is no conclusive scientific evidence establishing a causal relationship, are not addressed in this Directive. ..." (Introduction, paragraph 4).

37. So the protection of workers is only valid for averting thermal effects, and only in the short term!

38. Any potentially harmful biological effects are disregarded by the operators, agencies and official regulations, and to justify this attitude they abide by the contention that firstly, the ascertainment of a biological effect need not signify its being of a pathological character dangerous to the human constitution. Furthermore, they discern no absolutely conclusive scientific evidence of a cause and effect relationship between electromagnetic fields and radio frequencies and long-term pathological consequences of their non-thermal or athermic effects. And to emphasise these statements they invoke numerous scientific publications said to indicate no significant biological effect.

39. The operators' arguments on the whole can be summed up as follows:

- The threshold values recommended by the ICNIRP are values ensuring health security;
- Child mobile phone users are no more sensitive than adults;
- There are no significant biological effects apart from thermal effects;
- If there were any possibly harmful biological effects, moreover, there would be no scientifically acceptable mechanism of action to account for them.

9. Scientific studies and arguments pursued by associations and NGOs, by groupings of scientists, by the European Environment Agency and by the European Parliament

40. Serious scientific and medical studies revealing biological effects of a pathological nature have existed since the 1930s concerning radio frequencies and microwaves from radar installations. It also points out that harmful effects of protracted exposure to the low or very low frequency electromagnetic fields of electrical transmission lines or computer screens were observed already in the late 1970s, and the WHO's IARC (International Agency for Research on Cancer) classified these fields as "possibly carcinogenic" for humans (Group 2B) in 2001.

41. The rapporteur recalls the proven positive biological effects of certain medical applications (electrotherapies) of electromagnetic fields and microwaves at very low intensity. If there are such beneficial effects in certain frequency bands, then adverse biological effects on the human body should be just as much in the realm of plausibility or possibility.

42. Scientific studies concerning the negative effects of certain microwave frequencies on plants, insects and wildlife or farm animals are disturbing in more than one respect, and the scientific studies disclosing

potentially pathogenic biological effects on the human body are also important and not to be merely brushed aside.

43. These studies are very numerous indeed: the 2007 “Bioinitiative” report analysed over 2 000 of them, and more were added by an important monograph published in 2010 by the Ramazzini Institute, the national institute for study and control of cancer and environmental diseases “Bernardo Ramazzini” in Bologna, Italy.

44. A significant number of top scientists and researchers have banded together in a dedicated international body entitled ICEMS, “International Commission for Electromagnetic Safety”, in order to carry out independent research and recommend that the precautionary principle be applied in the matter. In 2006 (Benevento Resolution) and 2008 (Venice Resolution), these scientists published instructive resolutions calling for the adoption of far tougher new safety standards and rules.

45. Scientific studies disclose athermic or biological effects of electromagnetic fields or waves on cells, the nervous system, genetics, etc., which essentially fall into three categories: biological effects influencing the metabolism, sleep, the electrocardiogram profile; effects observed in experimentation on animals or in cell cultures (in vitro); effects emerging from epidemiological studies on prolonged use of mobile telephones or on living near high voltage power lines or base stations of relay antennas.

46. The term “biological effect” is used to refer to a physiological, biochemical or behavioural change brought about in a tissue or a cell in response to an external stimulus. Not every biological effect necessarily poses a serious threat to health; it may simply show the normal response of the cell, tissue or organism to that stimulus.

47. A medical or pathological biological effect, on the other hand, is an effect that may imperil the organism’s normal functioning by causing more or less severe symptoms or pathologies. Precisely, a growing number of scientific studies made by teams of high-level academic researchers demonstrate the existence of potentially or definitely pathological biological effects.

48. The rapporteur acknowledges that it is not possible within the compass of this report to analyse and summarise the findings of all these studies. A synopsis of the greater number of them (some 2 000) was produced in the “Bioinitiative” report, a report drawn up by 14 scientists of international standing who concurred, regarding mobile telephony and other radio frequencies, as to abnormally high incidence of brain tumours and acoustic neuroma, effects on the nervous system and cerebral functions, and effects on genes, cell stress proteins and the immune system. In this context, it has been observed for instance that radio frequency exposure can cause inflammatory and allergic reactions and impair the immune function even at levels well below the norms of exposure for the public.

49. A major programme of research into the specific features of these effects such as genotoxicity of waves (REFLEX programme), funded by the European Commission and involving 12 European research teams, was launched and the results were made public in December 2004. The conclusions of the report were disturbing on several counts as the results bore out genotoxic effects of mobile telephone waves, and in particular greater frequency of chromosomal deletions and breakup of DNA molecules in different types of cultivated human and animal cells. In addition, stress protein synthesis was greatly increased and gene expression was modified in various types of cells.

50. Concerning the Interphone study, the biggest epidemiological survey carried out on mobile phone users and their exposure to glioma, meningioma, acoustic neuroma and tumours of the parotid gland after protracted use of their mobile telephones, the partial early results published on 18 May 2010 by IARC more than ten years after the commencement of the study point to profound disagreement between the different teams of researchers (16 teams from 13 countries) over the interpretation of these results. The study co-ordinator, Ms Elisabeth Cardis, summed up a kind of compromise by saying that the study did not reveal an increased risk, but one could not conclude that there was no risk because there were sufficient results suggesting a possible risk. Indeed, some results show that lasting intensive use very significantly increases the risks of glioma (40% and even 96% looking at ipsilateral use, that is to say where the glioma has appeared at the side of the head to which the telephone was held) and the meningioma risks (15%; 45% for ipsilateral use).

51. The rapporteur feels that one of this epidemiological study’s principal weaknesses lies in the fact that the period of mobile phone use analysed, extending until the early years of the 21st century, is probably too short at less than 10 years to reach altogether conclusive results given the period of latency and growth of cerebral tumours. In fact, ionising radiation (radioactivity) is recognised as a cause of brain cancer, but cases due to radioactivity rarely become apparent before 10 or 20 years of exposure.

52. The Interphone study, performed solely on adults, nevertheless raises serious speculation as to what will happen, after 15 or 20 years of intensive use, to the young adults, teenagers or even children who are currently the biggest users and in whom absorption of the radiation is still greater and more problematic.

53. The rapporteur would like to emphasise another side of the potential risks: while attention is focused at present on the radiation from mobile phones, and while he appeals for the wisest possible use of this device, by children and young people especially, it is inescapable that for some years there have been many other sources of electromagnetic fields and radio frequencies.

54. Whether outside or inside offices and dwellings, we are now exposed to a whole variety of electromagnetic frequencies on top of the chemical pollutants in the air that we breathe or accumulated in the food chain. Outdoors or indoors, we encounter the electromagnetic fields or the radio frequencies of the (nearby) electric power lines and of the base stations of GSM, UMTS and WiFi relay antennas or of, for example, radio or radar stations. Besides these, inside offices or private residences there is very often the radiation of cordless telephones (DECT), baby phones and other devices of wireless technology.

55. What is more, industrialists seek a further expansion of mobile telephony infrastructures for hosting the "fourth generation" 4G facility with the intention of delivering a secure, comprehensive broadband mobile system for the cordless modems of laptop computers, "smart" mobile phones and other portable backup devices for broadband mobile Internet access, games services, etc.

56. In Israel, the ministries concerned (environment, health, communication) fall back on the application of the precautionary principle, opposing the introduction of these new infrastructures on the ground that the effects of the irradiations should be verified before authorising new systems.

57. A question that always strongly arouses the European populations is the problem of where base stations and relay antennas are sited. In parallel to certain local or regional studies (mainly Swiss and German) describing the advent of health problems in farm animals after the installation of mobile telephone relay antennas near some farms, describing unaccountable problems of fertility, deformity, cataracts, etc., certain local or regional epidemiological studies, carried out by groups of scientists and doctors, have succeeded in also showing certain disease symptoms in residents of districts or villages near relay antennas installed a few months or years ago. These local studies were carried out in France, Germany, Switzerland, Austria, etc.

58. According to these epidemiological and also partly clinical studies, symptoms appearing or increasing some time after relay antennas were commissioned or after the beams emitted were intensified by raising the number or the power of the antennas were sleeping disorders, headaches, blood pressure problems, dizziness, skin trouble and allergies. The scientific value of such local studies is regularly queried by the operators and very often the security and regulatory bodies too, and so a most recent study released early in 2011 in a German medical publication (Umwelt-Medizin-Gesellschaft 1/2011) is nonetheless worthwhile and revealing, although the number of participants in the study (60 persons) remains quite small. These persons, from the locality of Rimbach in Bavaria, underwent analysis before a new relay antenna base station came into service in January 2004, then afterwards in July 2004, January 2005 and July 2005. In this study, as in similar epidemiological studies, the symptoms that increased or became aggravated after the station began operating were sleep disorders, headaches, allergies, dizziness and concentration problems.

59. The worth of this study spanning a year and a half is that the doctors and scientists could measure and determine significant changes in concentrations of certain stress-related or other hormones in urine samples. To sum up the results, there is a significant increase of adrenalin and noradrenalin over several months and a significant reduction of dopamine and phenylethylamine (PEA), changes indicating a state of chronic stress which, according to the authors of the study, caused the aforesaid heightened symptoms. The authors correlate the lowered PEA levels with impaired attention and hyperactivity of children, disorders which hugely increased in Germany over the years 1990-2004.

60. Here, too, the rapporteur stresses that some people may be more sensitive than others to electromagnetic radiation or waves. The research performed, for instance, by Professor Dominique Belpomme, President of the Association for Research and Treatments Against Cancer (ARTAC), on more than 200 people describing themselves as "electrosensitive" succeeded, with corroborative results of clinical and biological analyses, in proving that there was such a syndrome of intolerance to electromagnetic fields across the whole spectrum of frequencies. According to these results, not only proximity to the sources of electromagnetic emissions was influential, but also the time of exposure and often concomitant exposure to chemicals or to (heavy) metals present in human tissues. In this context, Sweden has granted sufferers from

electromagnetic hypersensitivity the status of persons with reduced capacity so that they receive suitable protection.

61. In connection with the proven or potential risks of electromagnetic fields, it should also be noted that after a Lloyd's report, insurance companies tended to withhold coverage for risks linked with electromagnetic fields under civil liability policies, in the same way as, for example, genetically modified organisms or asbestos, which is hardly reassuring given the potential risks that stem from these electromagnetic fields.

62. Finally, the rapporteur wonders whether it might not be expedient and innovative to try and develop new wireless communication technologies, equally powerful but more energy-efficient and above all less problematic in terms of the environment and health than the present microwave-based wireless communication. Such systems, optical or optoelectronic communication technologies employing visible and infrared light, are reportedly being developed in the United States and Japan and could largely replace the present technologies. Should such changes in transmission and communication systems prove realistic, it would then be a case of technological and economic innovations not to be missed or obstructed.

10. Conclusions

63. The potentially harmful effects of electromagnetic fields on the environment and human health have not yet been fully elucidated and a number of scientific uncertainties continue to exist in that regard. Nevertheless, anxieties and fears remain in wide sectors of the population over the health hazards posed by the waves, and also of the demands voiced by high-level scientists, by groupings of doctors and by the associations of concerned citizens which abound in many Council of Europe member states.

64. The precautionary principle and the right to a healthy environment, particularly on behalf of children and future generations, must be key factors in all economic, technological and social development of society. In that regard, the Parliamentary Assembly has decided on several previous occasions (see Recommendation 1863 (2009) on environment and health: better prevention of environment-related health hazards and Recommendation 1959 (2011) on preventive health care policies in the Council of Europe member states) that coherent, effective preventive measures must be taken to protect the environment and human health.

65. After analysing the scientific studies available to date, and also following the hearings for expert opinions organised in the context of the Committee on the Environment, Agriculture and Local and Regional Affairs, there is sufficient evidence of potentially harmful effects of electromagnetic fields on fauna, flora and human health to react and to guard against potentially serious environmental and health hazards.

66. That was moreover already the case in 1999 and 2009 when the European Parliament overwhelmingly passed resolutions upholding the precautionary principle and efficient preventive actions vis-à-vis the harmful effects of electromagnetic fields, in particular by substantially lowering the exposure thresholds for workers and the general public according to the ALARA principle, by restoring genuine independence of research in that field, and through a policy of enhanced information and transparency towards the anxious populations (see European Parliament Resolution of 2 April 2009 on health concerns associated with electromagnetic fields, 2008/2211 INI).

67. Lastly, the Assembly could endorse the analyses and warnings issued first in September 2007, then in September 2009, by the European Environment Agency (EEA) concerning the health hazards of electromagnetic fields, mobile telephony and not least mobile phones. According to the EEA, there are sufficient signs or levels of scientific evidence of harmful biological effects to invoke the application of the precautionary principle and of effective, urgent preventive measures.

Organizations - Radiation Sickness; European Academy for Environmental Medicine, EUROPAEM EMF Guideline 2015 for the prevention, diagnosis and treatment of EMF-related health problems and illnesses; 2015

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EUROPAEM EMF Guideline 2015 for the prevention, diagnosis and treatment of EMF-related health problems and illnesses

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Abstract: Chronic diseases and illnesses associated with unspecific symptoms are on the rise. In addition to chronic stress in social and work environments, physical and chemical exposures at home, at work, and during leisure activities are causal or contributing environmental stressors that deserve attention by the general practitioner as well as by all other members of the health care community. It seems certainly necessary now to take “new exposures” like electromagnetic field (EMF) into account. Physicians are increasingly confronted with health problems from unidentified causes. Studies, empirical observations, and patient reports clearly indicate interactions between EMF exposure and health problems. Individual susceptibility and environmental factors are frequently neglected. New wireless technologies and applications have been introduced without any certainty about their

health effects, raising new challenges for medicine and society. For instance, the issue of so-called non-thermal effects and potential long-term effects of low-dose exposure were scarcely investigated prior to the introduction of these technologies. Common EMF sources include Wi-Fi access points, routers and clients, cordless and mobile phones including their base stations, Bluetooth devices, ELF magnetic fields from net currents, ELF electric fields from electric lamps and wiring close to the bed and office desk. On the one hand, there is strong evidence that long-term-exposure to certain EMF exposures is a risk factor for diseases such as certain cancers, Alzheimer’s disease and male infertility. On the other hand, the emerging electromagnetic hypersensitivity (EHS) is more and more recognized by health authorities, disability administrators and case workers, politicians, as well as courts of law. We recommend treating EHS clinically as part of the group of chronic multisystem illnesses (CMI) leading to a functional impairment (EHS), but still recognizing that

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the underlying cause remains the environment. In the beginning, EHS symptoms often occur only occasionally, but over time they may increase in frequency and severity. Common EHS symptoms include headaches, concentration difficulties, sleeping problems, depression, lack of energy, fatigue and flu-like symptoms. A comprehensive medical history, which should include all symptoms and their occurrences in spatial and temporal terms and in the context of EMF exposures, is the key to the diagnosis. The EMF exposure can be assessed by asking for typical sources like Wi-Fi access points, routers and clients, cordless and mobile phones and measurements at home and at work. It is very important to take the individual susceptibility into account. The primary method of treatment should mainly focus on the prevention or reduction of EMF exposure, that is, reducing or eliminating all sources of EMF at home and in the workplace. The reduction of EMF exposure should also be extended to public spaces such as schools, hospitals, public transport, and libraries to enable persons with EHS an unhindered use (accessibility measure). If a detrimental EMF exposure is reduced sufficiently, the body has a chance to recover and EHS symptoms will be reduced or even disappear. Many examples have shown that such measures can prove effective. Also the survival rate of children with leukemia depends on ELF magnetic field exposure at home. To increase the effectiveness of the treatment, the broad range of other environmental factors that contribute to the total body burden should also be addressed. Anything that supports a balanced homeostasis will increase a person's resilience against disease and thus against the adverse effects of EMF exposure. There is increasing evidence that EMF exposure has a major impact on the oxidative and nitrosative regulation capacity in affected individuals. This concept also may explain why the level of susceptibility to EMF can change and why the number of symptoms reported in the context of EMF exposures is so large. Based on our current understanding, a treatment approach that minimizes the adverse effects of peroxynitrite – as has been increasingly used in the treatment of multisystem disorders – works best. This EMF Guideline gives an overview of the current knowledge regarding EMF-related health risks and provides concepts for the diagnosis and treatment and accessibility measures of EHS to improve and restore individual health outcomes as well as for the development of strategies for prevention.

Keywords: accessibility measures; alternating; Alzheimer's; cancer; chronic multisystem illnesses (CMI); diagnosis; electric; electromagnetic field (EMF); electro-magnetic hypersensitivity (EHS); functional impairment;

infertility; leukemia; magnetic; medical guideline; nitrosative stress; nonionizing; oxidative stress; peroxynitrite; prevention; radiation; static; therapy; treatment.

Current state of the scientific and political debate from a medical perspective

Introduction

The Environmental Burden of Disease Project assessed the influence of nine environmental stressors (benzene, dioxins including furans and dioxin-like PCBs, second-hand smoke, formaldehyde, lead, noise, ozone, particulate matter and radon) on the health of the population of six countries (Belgium, Finland, France, Germany, Italy, and the Netherlands). Those nine environmental stressors caused 3%–7% of the annual burden of disease in the six European countries (1).

The Bundespsychotherapeutenkammer (BPtK) study in Germany showed that mental disorders had increased further and especially burnout as a reason of inability to work escalated seven-fold from 2004 to 2011 (2). In Germany, 42% of early retirements in 2012 were caused by mental disorders, depression being the leading diagnosis (3). In Germany, psychotropic drugs are at third place for the prescriptions of all drugs (4).

The consumption of methylphenidate (Ritalin, Medikinet, Concerta), a psychotropic drug prescribed as a treatment for attention deficit hyperactivity disorder (ADHD) especially for young children and adolescents, has increased alarmingly since the early 1990s. According to statistics of the German Federal Institute for Drugs and Medical Devices (Bundesinstitut für Arzneimittel und Medizinprodukte), prescriptions have increased even more dramatically since 2000 and reached a climax in 2012. In 2013, only a slight decline in the number of prescriptions was observed (5). Interestingly the rapid increase in the use of methylphenidate coincides with the enormous expansion of mobile telecommunication and other related technologies, posing an open research question.

In Germany, work disability cases and absence days due to mental health disorders more than doubled from 1994 to 2011 (6). In OECD countries, a huge variability in the prescription of antidepressants has occurred and generally an increasing trend has been observed. Socio-economic status and therapeutic standards cannot fully

explain these observations (7). Functional disturbances like chronic inflammation and changes of neurotransmitter functions caused by environmental influences are not investigated.

A steady increase in the prevalence of allergic/asthmatic diseases globally has occurred, with about 30%–40% of the world population now being affected by one or more allergic/asthmatic conditions (8).

It is suspected that environmental conditions such as the increasing exposure of the population to electromagnetic fields (EMFs) like radio-frequency radiation (RF), emanating from e.g. cordless phones (DECT), mobile phone base stations and cell phones (GSM, GPRS, UMTS, LTE) – especially smartphones, data cards for laptop and notebook computers, wireless LAN (Wi-Fi), wireless and powerline communication-based smart meters, but also exposure to extremely low frequency (ELF) electric and magnetic fields including “dirty electricity”, emanating from disturbances on the electric wiring, power lines, electric devices, and other equipment, do play a causal role for EMF-related health effects (9–12). For the society and the medical community, all of this raises new challenges.

Chronic diseases and illnesses associated with unspecific symptoms are on the rise. In addition to chronic stress in social and work environments, physical and chemical exposures at home, at work, and during leisure activities are causal or contributing environmental stressors that deserve attention by the general practitioner as well as by all other members of the health care community. It seems certainly necessary now to take “new exposures” like EMF into account.

Worldwide statements of organizations regarding EMF

The recommendations of the World Health Organization (WHO) regarding extremely low frequency (ELF) electric and magnetic fields and radio-frequency radiation, compiled by the International Commission on Non-Ionizing Radiation Protection (ICNIRP) (13, 14), are based on inductions of currents in the body and thermal effects (SAR values). These recommendations were adopted by the EU in its Council Recommendation of 1999 without taking into account long-term nonthermal effects. However, it should be stressed that at an international EMF conference in London (2008), Professor Paolo Vecchia, head of ICNIRP, said about the exposure guidelines “What they are not”: “They are not mandatory prescriptions for safety”, “They are not the ‘last word’ on the issue”, and “They are not defensive walls for industry or others” (15).

Even for short-term effects, the application of specific absorption rate (SAR) estimates seems to be not appropriate (16).

In contrast to the WHO headquarter in Geneva, the International Agency for Research on Cancer (IARC), a WHO-affiliated specialized agency in Lyon, classified extremely low frequency magnetic fields as possibly carcinogenic to humans (Group 2B) in 2002 (17) and radio-frequency radiation in 2011 (18).

In August 2007 and December 2012, the BioInitiative Working Group, an international group of experts, published comprehensive reports calling for preventive measures against EMF exposure based on the available scientific evidence (9, 10).

Since it is mostly neglected as a health hazard, the European Environment Agency compared the risks of non-ionizing radiation (EMF) to other environmental hazards such as asbestos, benzene and tobacco, urgently recommending to implement a precautionary approach regarding EMF (19). This position was confirmed and elaborated more deeply in further publications in 2011 and 2013 (20, 21).

In September 2008, a statement of the European Parliament called for a review of the EMF limits set out in the EU Council Recommendation of 1999, which was based on the ICNIRP guidelines, with reference to the BioInitiative Report (22). This was further strengthened in the European Parliament resolution of April 2009 (23).

In November, 2009, a scientific panel met in Seletun, Norway, for 3 days of intensive discussion on existing scientific evidence and public health implications of the unprecedented global exposures to artificial electromagnetic fields. Such electromagnetic field exposures (static to 300 GHz) result from the use of electric power and from wireless telecommunications technologies for voice and data transmission, energy, security, military and radar use in weather and transportation.

At the meeting, the Seletun Scientific Panel adopted a Consensus Agreement (24) that recommends preventative and precautionary actions that are warranted now, given the existing evidence for potential global health risks. It recognizes the duty of governments and their health agencies to educate and warn the public, to implement measures balanced in favor of the Precautionary Principle (25), to monitor compliance with directives promoting alternatives to wireless, and to fund research and policy development geared toward prevention of exposures and development of new public safety measures.

The Scientific Panel recognizes that the body of evidence on electromagnetic fields requires a new approach to protection of public health; the growth and development of the fetus, and of children; and argues for strong

preventative actions. These conclusions are built upon prior scientific and public health reports documenting the following:

- 1) Low-intensity (non-thermal) bioeffects and adverse health effects are demonstrated at levels significantly below existing exposure standards.
- 2) ICNIRP and IEEE/FCC public safety limits are inadequate and obsolete with respect to prolonged, low-intensity exposures.
- 3) New, biologically-based public exposure standards are urgently needed to protect public health world-wide.
- 4) It is not in the public interest to wait.

The Panel also strongly recommends that persons with electromagnetic hypersensitivity symptoms (EHS) be classified as functionally impaired in all countries rather than with “idiopathic environmental disease” or similar indistinct categories. This terminology will encourage governments to make adjustments in the living environment to better address social and well-being needs of this subpopulation of highly sensitive members of society, and – as a consequence – protect everyone now as well as in the coming generations from toxic environmental exposures.

It is important to note that numeric limits recommended by the Seletun Scientific Panel, as well as by other bodies of society, do not yet take into account sensitive populations (EHS, immune-compromised, the fetus, developing children, the elderly, people on medications, etc.). Another safety margin is, thus, likely justified further below the numeric limits for EMF exposure recommended by the Panel.

In May 2011, the Parliamentary Assembly of the Council of Europe adopted the report “The potential dangers of electromagnetic fields and their effects on the environment” (26). The Assembly recommended many preventive measures for the member states of the Council of Europe with the aim to protect humans and the environment, especially from high-frequency electromagnetic fields such as: “Take all reasonable measures to reduce exposure to electromagnetic fields, especially to radiofrequencies from mobile phones, and particularly the exposure of children and young people who seem to be most at risk from head tumors” or “Pay particular attention to “electrosensitive” people who suffer from a syndrome of intolerance to electromagnetic fields and introduce special measures to protect them, including the creation of wave-free areas not covered by the wireless network.”

Recognizing that patients are being adversely affected by EMF exposure, the American Academy of

Environmental Medicine published recommendations regarding EMF exposure in July 2012. The AAEM called for physicians to consider electromagnetic exposure in diagnosis and treatment and recognize that EMF exposure “may be an underlying cause of the patient’s disease process” (27).

Since 2014 the Belgium government has prohibited the advertising of cell phones for children under the age of seven and has required the specific absorption rate (SAR) of cell phones be listed. Furthermore, at the point of sale, well-marked warnings must be posted that instruct users to use headsets and to minimize their exposure (28).

In January 2015, the French parliament adopted a comprehensive law that protects the general public from excessive exposure to electromagnetic waves. Among other things, it was passed to ban Wi-Fi in nurseries for children under the age of three and to enable Wi-Fi at primary schools with children under the age of 11 only when used specifically for lessons. Public places offering Wi-Fi must clearly advertise this fact on a sign. At the point of sale of cell phones, the SAR value must be clearly shown. In the future, any cell phone advertisement must include recommendations on how users can reduce RF radiation exposure to the head such as the use of headsets. Data on local EMF exposure levels shall be made more easily accessible to the general public, among others, through country-wide transmitter maps. Also, the French government will have to submit a report on electromagnetic hypersensitivity to the parliament within a year (29).

In May 2015 almost 200 scientists directed an international appeal to United Nations (UN) and WHO and called for protection from nonionizing electromagnetic field exposure. In the appeal the scientifically proven effects on health and the hitherto inadequate international guidelines (ICNIRP) and their use by WHO had been addressed. In addition, various demands were made in nine points, such as that: “the public be fully informed about the potential health risks from electromagnetic energy and taught harm reduction strategies” and “that medical professionals be educated about the biological effects of electromagnetic energy and be provided training on treatment of patients with electromagnetic sensitivity” (30).

Finally, in 2015 Pall (12) published a comprehensive paper with the title “Scientific evidence contradicts findings and assumptions of Canadian Safety Panel 6: microwaves act through voltage-gated calcium channel activation to induce biological impacts at non-thermal levels, supporting a paradigm shift for microwave/lower frequency electromagnetic field action”.

EMF and cancer

Except for a few investigations in occupational settings, epidemiological research of EMF started in 1979 when Wertheimer and Leeper published their study about the relationship between the proximity to so-called power line poles with “service drop” wires and the occurrence of childhood cancer (specifically leukemia and brain tumors) (31). At the same time Robinette et al. studied mortality in a cohort of Korean War veterans having been trained on military radars in the early 1950s (32). Both studies found indications of increased risks and initiated a new era of studying health-relevant effects from exposure to EMFs.

In the following years, a large number of investigations about the relationship between childhood leukemia and extremely low frequency magnetic fields (ELF MF) have been published. However, the results seemed inconsistent until in 2000 two pooled analyses (33, 34) were conducted, providing little indication of inconsistency and demonstrating an increase of leukemia risk with increasing average exposure levels that was significant for levels above 0.3 or 0.4 μT relative to averages below 0.1 μT but without indication of a threshold. Based on these findings, the International Agency for Research on Cancer (IARC) classified ELF MF in 2002 as a Group 2B (possible) carcinogen (17). To this category belong e.g. lead, DDT, welding fumes, and carbon tetrachloride.

Since then additional epidemiological studies have been conducted that gave essentially the same results (35, 36). In a review on childhood leukemia and ELF MF, Kundi concluded that there is sufficient evidence from epidemiological studies of an increased risk for childhood leukemia from exposure to power-frequency MF that cannot be attributed to chance, bias, or confounding. Therefore, according to the rules of IARC, such exposures ought to be classified as a Group 1 (definite) carcinogen (10).

The prognosis of certain diseases can be influenced by EMF-reduction. For example, children who have leukemia and are in recovery have poorer survival rates if their ELF magnetic field exposure at home (or where they are recovering) is between 1 mG [0.1 μT] and 2 mG [0.2 μT] or above 2 mG [0.2 μT] in one study, over 3 mG [0.3 μT] in another study (9).

Epidemiological studies of radio-frequency fields before the general rise in exposure to mobile telecommunication networks was quite restricted and only a few studies had been conducted in the vicinity of radio transmitters, radar stations, other occupational exposures, a in radio amateurs. After the introduction of digital mobile telephony, the number of users of mobile phones increased dramatically and it was recommended in the 1990s to

perform epidemiological studies with a focus on intracranial tumors. Since the first publication in 1999 by the Swedish group around Prof. Lennart Hardell (37), about 40 studies have been published. The majority of these studies investigated brain tumors, but also salivary gland tumors, uveal melanoma, nerve sheath tumors, testicular cancer, and lymphoma. Many of these studies are inconclusive because of too short exposure durations; however, two series of investigations, the international Interphone study conducted in 13 countries and the Swedish studies of the Hardell group, had a significant proportion of long-term mobile phone users and could in principle be used for risk assessment. In 2011, IARC classified radio-frequency electromagnetic fields (RF) as a Group 2B carcinogen based on evidence from epidemiological studies and animal experiments (18). Since then, additional studies have corroborated the assumption of a causal relationship between mobile phone use and cancer (38–40). Hardell and Carlberg (41) concluded that RF-EMF ought to be classified as a definitive human carcinogen (IARC Group 1). The evidence for a causal relationship between long-term mobile and cordless phone use and the risk for glioma has increased further in 2015 (42).

In Italy, the Supreme Court upheld a ruling in October 2012 for an 80% disability rating and permanent disability pension due to a tumor, which was causally connected with the occupation-related heavy use of cell and cordless phones (43).

EMF and neurodegeneration

Neurological effects are caused by changes in the nervous system, including direct damage (neurodegeneration) to nerve cells and their processes, the axons and dendrites, as well as their terminal common functional entities, the synapses with their receptors, ion channels and comodulators. Factors that act directly or indirectly on the nervous system causing morphological, chemical, and/or electrical changes in the nervous system can lead to neurological alterations. The final manifestation of these effects can be seen in neurocognitive changes, e.g. memory, learning and perception, as well as in primary sensory and motor incapacities.

The nervous system is an electrical organ based on a very complex chemistry. Thus, it should not be surprising that exposure to electromagnetic fields could lead to neurodegeneration and concomitant or consecutive neurological changes. Morphological, chemical, electrical, and behavioral changes have been reported in animals, cells and tissues after exposure to electromagnetic fields across a range of frequencies.

The consequences of physiological changes in the nervous system are very difficult to assess. We do not fully understand how the nervous system functions and reacts to external perturbations. The neuronal plasticity of the nervous system could compensate for external disturbances, at least to a certain degree. On the other hand, the consequence of neural perturbation is also situation-dependent. An EMF-induced severe change in brain performance, for instance, could lead to different consequences depending on whether a person is sitting in a sofa watching TV or driving a car. The latter could very well end dramatically, even fatally.

It should be noted that analyses of the recent neurological literature show that there are more publications showing effects than no effects. So the question is not if EMFs cause effects, but rather how serious they will be for a given person.

Neurological effects of radio-frequency radiation (RFR)

There are many studies on human subjects. Many of the published papers are on changes in brain electrical activities, the EEG, as well as impacts on sleep, after acute exposure to cell phone radiation.

Bak et al. (44) reported effects on event-related potentials. Maganioti et al. (45) further reported that RFR affected the gender-specific components of event-related potentials [see also Hountala et al. (46)]. Croft et al. (47) reported changes of the alpha wave power in the EEG. The same authors (48) further reported that effects differed between various new cell phone transmission systems, which have different signaling characteristics. They observed effects after exposure to second generation (2G), but not third generation (3G) radiation, whereas Leung et al. (49) found similar EEG effects with both 2G and 3G types of radiation. Lustenberger et al. (50) found increased slow-wave activity in humans during exposure to pulse-modulated RF EMF toward the end of the sleep period. Vecchio and associates reported that cell phone RFR affected EEG and the spread of neural synchronization conveyed by interhemispherical functional coupling of EEG rhythms (51) and enhanced human cortical neural efficiency (52). An interesting finding is that RFR could interact with the activity of brain epileptic foci in epileptic patients (53, 54). However, no significant effect on EEG was reported by Perentos et al. (55) or Trunk et al. (56). And Kleinlogel et al. (57, 58) also reported no significant effects on resting EEG and event-related potentials in humans after exposure to cell phone RFR. Furthermore, Krause et al. (59) reported no significant effect of cell

phone radiation on brain oscillatory activity, and Inomata-Terada et al. (60) concluded that cell phone radiation does not affect the electrical activity of the motor cortex.

There are studies on the interaction of cell phone radiation on EEG during sleep. Changes in sleep EEG have been reported by Hung et al. (61), Regel et al. (62), Lowden et al. (63), Schmid et al. (64, 65), and Loughran et al. (66), whereas no significant effect was reported by Fritzer et al. (67), Mohler et al. (68, 69) and Nakatani-Enomoto et al. (70). Loughran et al. (66) provided an interesting conclusion in their paper: "These results confirm previous findings of mobile phone-like emissions affecting the EEG during non-REM sleep". Importantly, this low-level effect was also shown to be sensitive to individual variability. Furthermore, this indicates that "previous negative results are not strong evidence for a lack of an effect..." Increase in REM sleep was reported by Pelletier et al. (71) in developing rats after chronic exposure. Mohammed et al. (72) reported a disturbance in REM sleep EEG in the rat after long term exposure (1 h/day for 1 month) to a 900-MHz modulated RFR. A Swiss Study revealed that, under pulse-modulated radiofrequency electromagnetic field exposure, sleep slow-wave activity is increased and – fitting to that – the sleep-dependent performance improvement is decreased (50).

Among the very many effects reported in the ever increasing number of scientific papers are also reduction in behavioral arousal, sleep latency alterations, effects on cognitive functions and EEG, on spatial working memory, on well-being, influences on overall behavioral problems in adolescents, alteration of thermal pain threshold and visual discrimination threshold, respectively, induced hyperactivity, hypoactivity and impaired memory, respectively, contextual emotional behavior deficit, olfactory and/or visual memory deficit, impact on food collection behavior (in ants), decreased motor activity, learning behavior deficit, induction of stress behavioral patterns, passive avoidance deficit, and reduced memory functions.

Almost all the animal studies reported effects, whereas more human studies reported no effects than effects. This may be caused by several possible factors: (a) Humans are less susceptible to the effects of RFR than are rodents and other species. (b) Non-thermal effects of RFR depend on a number of physical and biological parameters (73). The same exposure can induce effects in certain biological species while being ineffective in others. IARC also admits that some of the discrepancies between RFR studies could be due to differences in species [(18), p. 416]. (c) It may be more difficult to do human than animal experiments, since, in general, it is easier to control the variables and confounding factors in an animal experiment. (d) In the animal studies, the cumulative exposure duration was

generally longer and studies were carried out after exposure, whereas in the human studies, the exposure was generally at one time and testing was done during exposure. This raises the question of whether the effects of RFR are cumulative. This consideration could have very important implications on real-life human exposure to EMF. However, it must be pointed out that neurophysiological and behavioral changes have been reported in both animals and humans after acute (one-time) exposure to RFR, and most of the EEG studies mentioned above are acute exposure experiments.

Neurological effects of extremely low frequency electromagnetic fields (ELF-EMF)

A number of authors have reported effects of ELF-EMF on various animal transmitter receptors in the brain such as NMDA receptors, dopamine and serotonin receptors, including the 5HT(2A) subtype of serotonin receptors. The latter is classically, particularly in the frontal cortex, believed to be related to the psychiatric syndromes of depression in humans. Kitaoka et al. (74) and Szemerszky et al. (75) did report depression-like behavior in both mice and rats, after chronic exposure to ELF magnetic fields. There are two reports on dopamine receptors. Shin et al. (76, 77) reported an increase in D-1 dopamine receptors and activity in the striatum of the rat after ELF magnetic field exposure. Dopamine in the striatum is, of course, involved in Parkinson's disease. Wang et al. (78) reported that ELF magnetic fields potentiated morphine-induced decrease in D-2 dopamine receptors. Both D-1 and D-2 dopamine receptors in the brain are involved in depression and drug addiction. Ravera et al. (79) reported changes in the enzyme acetylcholinesterase in cell membrane isolated from the cerebellum after ELF magnetic field exposure. Interestingly, these researchers also reported "frequency window" effects in their experiment. Window effects, i.e. effects are observed at a certain range(s) of EMF frequencies or intensities, were first reported by Ross Adey, Susan Bawin, and Carl Blackman in the 1980s. A study by Fournier et al. (80) reported an 'intensity window' effect of ELF magnetic field on neurodevelopment in the rat. The cholinergic systems in the brain play a major role in learning and memory functions.

Behavioral effects of ELF-EMF have been further substantiated in recent research. These include: changes in locomotor activity (76, 77, 81–86), learning and memory functions (80, 87–95), anxiety (81, 93, 96–98), depression-like behavior (74, 75), perception (99), cognitive dysfunction (100), emotional state (101), sleep onset (61), and comb building in hornets (102). As different behavioral

effects have been observed in different exposure conditions, species of animals, and testing paradigms, they provide the strongest evidence that exposure to ELF-EMF can affect the nervous system.

The possible medical applications of ELF-EMF should also be given more attention. Several studies indicate that ELF-EMF (however, mostly at high exposure levels) could enhance recovery of functions after nervous system damage and have protective effects against development of neurodegenerative diseases. The majority of the studies used magnetic fields above 0.1 mT (1 gauss; the highest was 8 mT). The intensities are much higher than those in the public environment. Thus, caution should be taken in extrapolating the high-intensity cell and animal studies to long-term environmental human exposure situations.

In addition, however, there are studies at low or very low magnetic field exposure levels. Humans are sensitive to magnetic fields at levels $<1 \mu\text{T}$. A study by Ross et al. (99) showed "perception" alteration in human subjects exposed to a magnetic field at 10 nT (0.00001 mT), a study by Fournier et al. (80) showed an effect on brain development in the rat at 30 nT (0.00003 mT), and a study by Stevens (101) indicated changes in emotional states in humans exposed to 8–12 Hz magnetic fields at 5 μT (0.005 mT). These data do suggest magnetic fields at very low intensities could cause neurological effects in humans. In the 1990s, there was a series of more than 20 studies published by Reuven Sandyk, showing that pulsed magnetic fields at picotesla levels (1 pT=0.000000001 mT) could have therapeutic effects on Parkinson's disease and multiple sclerosis [see e.g. (103)]. However, Sandyk's findings have never been independently confirmed.

The above mentioned therapeutic applications of EMF elicit that different EMF-exposures have biological effects under certain conditions for short-term use.

Alzheimer's disease

Amyloid beta ($A\beta$) protein is generally considered the primary neurotoxic agent causally associated with Alzheimer's disease. $A\beta$ is produced by both brain and peripheral cells and can pass through the blood brain barrier.

The BioInitiative review 2012 (10) summarized the evidence concerning Alzheimer's disease as follows:

- 1) There is longitudinal epidemiologic evidence that high peripheral blood levels of $A\beta$, particularly $A\beta$ 1-42, are a risk factor for Alzheimer's disease.
- 2) There is epidemiologic evidence that extremely low frequency (ELF, 50–60 Hz) magnetic field (MF) exposure upregulates peripheral blood levels of $A\beta$.

- 3) There is evidence that melatonin can inhibit the development of Alzheimer's disease and, thus, low melatonin levels may increase the risk of Alzheimer's disease.
- 4) There is strong epidemiologic evidence that significant (i.e. high), occupational ELF-MF exposure can lead to the downregulation of melatonin production. The precise components of the magnetic fields causing this downregulation are unknown. Other factors which may influence the relationship between ELF-MF exposure and melatonin production are unknown, but certain medications may play a role.
- 5) There is strong epidemiologic evidence that high occupational ELF MF exposure is a risk factor for Alzheimer's disease, based on case-control studies which used expert diagnoses and a restrictive classification of ELFMF exposure.
- 6) There are only single epidemiologic studies of Alzheimer's disease and radio-frequency electromagnetic field exposure, and only one epidemiology study of non-acute radio-frequency electromagnetic field exposure and melatonin. So, no final conclusions concerning health consequences due to RF exposure and Alzheimer's disease are currently possible.

Hallberg and Johansson (104) demonstrated that the mortality in Alzheimer's disease appears to be associated with mobile phone output power. Deeper studies in this complex area are still necessary.

There is epidemiological evidence that also residential exposure to ELF magnetic fields is associated with an increased risk for Alzheimer's disease (105, 106).

Earlier reviews of the association between exposure to ELF MF and neurodegenerative diseases came to different conclusions (107, 108). The discrepancy is mainly due to two aspects: the assessment of a possible publication bias and the selection and classification of exposed groups. Since most studies are about occupational exposure, it is mandatory to avoid misclassification. If care is taken to avoid such ambiguity, there is a clear meta-analytical relationship and an increased risk for Alzheimer's disease and amyotrophic lateral sclerosis (ALS). This association shows little heterogeneity across studies if the different methodologies are considered and publication bias has been detected for studies relying on mortality registries only (109).

EMF and infertility and reproduction

Infertility and reproduction disorders are on the rise. The BioInitiative review 2012 (10) summarized the evidence

concerning infertility and reproduction as follows – with small adaptations by the authors:

Human sperm are damaged by cell phone radiation at very low intensities, in the low microwatt and nanowatt per cm² range (0.00034–0.07 $\mu\text{W}/\text{cm}^2=3.4\text{--}700 \mu\text{W}/\text{m}^2$). There is a veritable flood of new studies reporting sperm damage in humans and animals, leading to substantial concerns for fertility, reproduction, and health of the offspring (unrepaired de novo mutations in sperm). Exposure levels are similar to those resulting from wearing a cell phone on the belt or in a pants pocket, or from using a wireless laptop computer on the lap. Sperm lack the ability to repair DNA damage.

Several international laboratories have replicated studies showing adverse effects on sperm quality, motility, and pathology in men who use cell phones and particularly those who wear a cell phone, PDA, or pager on their belt or in a pocket (110–115). Other studies conclude that the use of cell phones, exposure to cell phone radiation, or storage of a cell phone close to the testes of human males affect the sperm count, motility, viability, and structure (110, 116, 117). Animal studies have demonstrated oxidative and DNA damage, pathological changes in the testes of animals, decreased sperm mobility and viability, and other measures of deleterious damage to the male germ line (118–122).

There are fewer animal studies that have studied effects of cell phone radiation on female fertility parameters. Panagopoulos (123) report decreased ovarian development and size of ovaries, and premature cell death of ovarian follicles and nurse cells in *Drosophila melanogaster*. Gul et al. (124) report rats exposed to standby level RFR (phones on but not transmitting calls) caused decrease in the number of ovarian follicles in pups born to these exposed dams. Magras and Xenos (125) reported irreversible infertility in mice after five (5) generations of exposure to RFR at cell phone tower exposure levels of less than one microwatt per centimeter squared ($<1 \mu\text{W}/\text{cm}^2=<10 \text{mW}/\text{m}^2$).

Electromagnetic hypersensitivity (EHS)

An increasing number of human beings are continuously exposed in their daily life to increasing levels of a combination of static, ELF and VLF electric and magnetic fields and RF electromagnetic fields. These exposures are of different signal patterns, intensities, and technical applications for varying periods of time. All these fields are summarized as EMF, colloquially referred to as “electrosmog”.

In a questionnaire survey in Switzerland in 2001, which was addressed to persons attributing specific health problems to EMF exposure, of the 394 respondents 58% suffered from sleep problems or disorders, 41% from headaches, 19% from nervousness, 18% from fatigue and 16% from difficulties with concentration. The respondents attributed their symptoms, e.g. to mobile phone base stations (74%), cell phones (36%), cordless phones (29%), and high-voltage power lines (27%). Two thirds of the respondents had taken measures to reduce their symptoms, the most frequent one being to avoid exposure (126).

In a survey conducted 2009 in a Japanese EHS and multiple chemical sensitivity (MCS) self-help group ($n=75$), 45% of the respondents had EHS as a medical diagnosis, 49% considered themselves EHS. Every second responder had medically diagnosed MCS (49%) and self-diagnosed MCS had 27%. The main EHS-related symptoms were fatigue (85%), headache (81%), concentration problems (81%), sleeping disorders (76%) and dizziness (64%). The most frequent causes include: base stations (71%), other persons mobile phones (64%), PC (63%), power lines (60%), television (56%), own mobile phone (56%), public transportation (55%), cordless phones (52%), air conditioner (49%) and car (49%). Suspected EMF source of EHS onset were: mobile phone base stations (37%), PC (20%), electric home appliances (15%), medical equipment (15%), mobile phones (8%), power lines (7%) and induction cookers (7%) (127).

In 2001, 63 persons who attributed health problems to environmental exposure were counseled in an interdisciplinary environmental medicine pilot project in Basel. An interdisciplinary expert team assessed the individual symptoms by a medical psychological-psychiatric and environmental examination, including visits and environmental measurements at home. With respect to the 25 persons with EHS, the expert team attested that in one third of them, at least one symptom was plausibly related to electrosmog, although the EMF exposure was within the Swiss limits. They concluded that persons with EHS should be advised interdisciplinary, not only medically and psychologically but also environmentally (128, 129).

A representative telephone survey ($n=2048$; age >14 years) carried out in 2004 in Switzerland yielded a frequency of 5% (95% CI 4%–6%) for having symptoms attributed to electrosmog, so-called electromagnetic hypersensitivity. Remarkably, only 13% consulted their family doctor. Individuals with a past history of symptoms attributable to EMF gave “turned off the source” as the answer three times as often as the ones who still had symptoms (130).

In a Swiss questionnaire study of GPs in 2005, two-thirds of the doctors were consulted at least once a year because of symptoms attributed to EMF. Fifty-four percent of the doctors assessed a relation as possible. The doctors in this questionnaire asked for more general information about EMF and health and instructions on how to deal with persons with EHS (131).

In another questionnaire study, also mandated by the Swiss Federal Government and performed by the University of Bern in 2004, Swiss doctors working with complementary diagnostic and therapeutic tools reported that 71% of their consultations related to EMF. Remarkably, not only the patients, but even more so the doctors suspected a possible relation between illness and EMF. The reduction or elimination of environmental sources was the main therapeutic instrument in treating symptoms related to EMF (132).

A questionnaire study of Austrian doctors yielded similar results. In this study, the discrepancy between the physicians' opinions and established national and international health risk assessments was remarkable, considering that 96% of the physicians believed to some degree in or were totally convinced of a health-relevant role of environmental electromagnetic fields (133).

The question, whether EHS is causally associated with EMF exposure remains controversial. On the one hand, physicians judge a causal association between EMF exposures as plausible based on case reports, on the other hand, national and international health risk assessments mostly claim that there is no such causal association, because provocation studies under controlled blinded conditions mostly failed to show effects. However, all these studies used a very limited number of exposure conditions, the exposure duration and the examined effects were short, and the recruitment of the persons with EHS was not medically assessed.

The WHO, for example, does not consider EHS as a diagnosis and recommends to medical doctors that the treatment of affected individuals should focus on the health symptoms and the clinical picture, and not on a person's perceived need for reducing or eliminating EMF in the workplace or home (134).

The evaluation report about electromagnetic hypersensitivity mandated by the Swiss federal government assessed the evidence of a causal relationship between EMF exposure and biological and health effects. It took into account not only experimental, observational studies and meta-analyses, but also individual experiments and case reports. For the evaluation of the scientific evidence, the GRADE criteria were applied. Individual case reports were considered to be of great importance because it is

likely that, at the same exposure level, not all people react the same as rare cases may be misunderstood by otherwise statistically reliable scientific methods of investigation, and since habituation and sensitization processes of a person's reaction can change during the time of exposure. The significance of case reports with regard to scientific evidence based on the strict GRADE criteria used in this evaluation, however, was considered to be limited, mainly because of the distortion due to methodological flaws. It was noted in the report that individual case experiments with repeated testing of an EHS person under double-blind conditions and controlled exposure would be more revealing than experimental studies with larger groups. Ideally, a test of the person concerned should be carried out in their familiar surroundings (e.g. at home) with a reliable and accurate measurement of exposure. With positive test results, a re-evaluation would be required also from a scientific perspective (135).

The paper "Electromagnetic hypersensitivity: fact or fiction" by Genius and Lipp (136) offers an instructive review of studies of the last decades concerning EHS, including historical milestones, reviews, pathogenesis, biochemical markers, therapeutic management, as well as the debate about the legitimacy of EHS.

In Sweden, EHS is an officially fully recognized functional impairment (i.e. it is not regarded as a disease). Survey studies show that somewhere between 230,000 and 290,000 Swedish men and women out of a population of 9,000,000 – report a variety of symptoms when being in contact with EMF sources. With reference to UN Resolution 48/96, Annex, of 20 December 1993, the Swedish government grants support to individuals with EHS. Employees with EHS have a right to support from their employers so as to enable them to work despite this impairment. Some hospitals in Sweden provide rooms with low-EMF exposure (137).

In Sweden, impairments are viewed from the point of the environment. No human being is in itself impaired; there are instead shortcomings in the environment that cause the impairment (as with the lack of ramps for the person in a wheelchair or rooms requiring low-EMF remediation for the person with EHS). Furthermore, this environment-related perspective of the impairment EHS means that – even though we do not have a complete scientific explanation, and, in contrast, to what many individuals involved in the EMF discourse at present think – any person with EHS shall always be met in a respectful way and with all necessary support required to eliminate the impairment. This implies that the person with EHS shall have the opportunity to live and work in a low-EMF environment (138).

In Sweden, the City of Stockholm offers low-EMF housing on its outskirts to electrosensitive individuals. In France, the first low-EMF zone has been established at Drôme in July 2009 (139). In Austria, the construction of a multi-family house has been planned for 2015, which was designed by a team of architects, building biology professionals, and environmental medicine health care professionals to provide a sustainable healthy living environment. Both the outdoor and indoor environments were explicitly chosen and designed to meet low-EMF requirements (140). The implementation of low-EMF zones for electrosensitive individuals is pursued in numerous countries. The realization of such projects greatly depends on the understanding, knowledge, and tolerance of the members of the chosen community.

In a human provocation study, Johansson (141), using a controlled, double-blind pilot setup, found one EHS person that correctly identified the presence of a mobile phone nine times out of nine provocations ($p < 0.002$), both in the "acute" phase as well as in the "chronic" phase ($p < 0.001$).

In facial skin samples of electrosensitive persons, the most common finding has been a profound increase of mast cells (142). From this and other studies, it is clear that the number of mast cells in the upper dermis is increased in the EHS group. A different pattern of mast cell distribution also occurred in the EHS group. Finally, in the EHS group, the cytoplasmic granules were more densely distributed and more strongly stained than in the control group, and the size of the infiltrating mast cells was generally found to be larger in the EHS group as well. It should be noted that increases of similar nature later on were demonstrated in an experimental situation, employing normal healthy volunteers in front of cathode ray tube (CRT) monitors, including ordinary household television sets (143).

In one of the early papers, Johansson et al. (144) made a sensational finding when they exposed two electrically sensitive individuals to a TV monitor situated at a distance of 40–50 cm away from them. The scientists used an open-field provocation in front of an ordinary TV set with persons regarding themselves as suffering from skin problems due to work at video display terminals. Employing fluorescence microscopy-based immunohistochemistry, in combination with a wide range of antisera directed towards cellular and neurochemical markers, they were able to show a high to very high number of somatostatin-immunoreactive dendritic cells as well as histamine-positive mast cells in skin biopsies from the anterior neck taken before the start of the provocation. At the end of the provocation, however the number of mast cells was unchanged and the somatostatin-positive cells had seemingly disappeared. The reason for this latter

finding could be discussed in terms of loss of immunoreactivity, increase of breakdown, etc. The high number of mast cells present may explain the clinical symptoms of itch, pain, edema, and erythema.

Against this background, it is interesting to see that the early Swedish findings from the 1980s and 1990s are supported by the latest work of Belpomme and Irigaray (145). Since 2009, Belpomme and Irigaray prospectively investigated clinically and biologically 1200 consecutive EHS and/or MCS-self reported cases in an attempt to establish objective diagnosis criteria and to elucidate the pathophysiological aspects of these two disorders.

In their preliminary results, as presented at the Fifth Paris Appeal Congress in Belgium in 2015 – based on the analysis of 839 originally enrolled cases of which 810 met the inclusion criteria and 727 were evaluable – 521 were diagnosed with EHS, 52 with MCS, and 154 with both EHS and MCS. Concomitant multiple food intolerance was found in 28.5%, 41.9%, and 70.4% of the cases in the three groups, respectively. Histamine levels were analyzed in the blood of patients, and 37%, 36.7% and 41.5% of the persons respectively in the three above individualized groups showed a significant increase in histamine-mia (>10 nmol/L), meaning that a chronic inflammatory response can be detected in these patients.

They also measured nitrotyrosin (NTT), a marker of both peroxynitrite (ONOO $^-$) production and opening of the blood brain barrier (BBB). NTT was increased in the blood (>0.90 μ g/mL) in 29.7%, 26%, and 28% of the cases in the three groups, respectively. Likewise protein S100B, another marker of BBB opening was found to be increased in the blood (>0.105 μ g/L) in 14.7%, 19.7%, and 10.7% of their cases, respectively. Circulating antibodies against O-myelin, heat shock protein (Hsp) 27, and/or Hsp 70 protein were also found to be increased in 43.1%, 25%, and 52% of their cases, respectively, indicating that EHS and MCS are associated with some autoimmune response. Since most patients reported chronic insomnia and fatigue, they also determined the 24-h urine melatonin/creatinine ratio and found it was decreased (<0.8) in all investigated cases.

Finally, in order to gain further information about the underlying mechanisms of EHS and MCS, they serially measured the brain blood flow in the temporal lobes of each patient by using pulsed brain echodoppler. They found that both EHS and MCS were associated with a hypoperfusion in the capsulo-thalamic area of the brain, suggesting that the inflammatory process may in fact involve the limbic system and the thalamus. Both EHS and MCS thus appear to paint a common picture of inflammation-related hyper-histaminemia, oxidative stress, autoimmune

response, and BBB opening, and a deficit in melatonin excretion. According to Belpomme and Irigaray, EHS and MCS probably share a common pathological mechanism mainly involving the central nervous system (145).

While a 2006 study by Regel et al. (146) described no exposure effects, two provocation studies on exposure of “electrosensitive” individuals and control subjects to mobile phone base station signals (GSM, UMTS or both) found a significant decline in well-being after UMTS exposure in the individuals reporting sensitivity (147, 148). Most so-called provocation studies with EHS show no effects. However, all these studies used a very limited number of exposure conditions. Taking in account the strong dependence of EMF effects on a variety of physical and biological variables (73), available provocation studies are scientifically difficult to interpret and, in fact, are not suitable to disprove causality.

There is increasing evidence in the scientific literature of various subjective and objective physiological alterations, e.g. heart-rate variability (HRV) as apparent in some persons with EHS claiming to suffer after exposure to certain frequencies of EMR like DECT or Wi-Fi (149–153).

Analysis of the data available on the exposure of people living near mobile phone base stations has yielded clear indications of adverse health effects like fatigue, depression, difficulty in concentrating, headaches, dizziness, etc. (154–158).

The frequency spectrum between ELF and RF is referred as kHz range or intermediate frequency range. Residential exposures in this range are often due to “dirty power”/ “dirty electricity” originating from voltage and/or current perturbations from diverse sources like electronic power supplies for TVs, monitors, PCs, motor drives, inverters, dimmers, CFLs, phase-angle control devices, as well as sparking and arcing from switching operations and from electric motors with brushes. The kHz waves/transients travel along the electric wiring and grounding systems (conducted emissions) and radiate electric and/or magnetic fields into free space (radiated emissions), leading to human exposures in the vicinity.

Epidemiological evidence links dirty electricity to most of the diseases of civilization including cancer, cardiovascular disease, diabetes, suicide, and attention deficit hyperactivity disorder in humans (159).

When it comes to health effects of static magnetic fields, this type of EMF exposure is frequently underestimated. Blackman reports in the 2007 BioInitiative Report (9): “The magnetic field of the earth at any given location has a relatively constant intensity as a function of time. However, the intensity value, and the inclination of the field with respect to the gravity vector, varies considerable

over the face of the earth. More locally, these features of the earth's magnetic field can also vary by more than 20% inside man-made structures, particularly those with steel support structures. There are many reports of EMF-caused effects being dependent on the static magnetic field intensity (cf. Blackman et al., 1985) and of its orientation, with respect to an oscillating magnetic field (Blackman et al., 1990; Blackman et al., 1996). One aspect common to many of these reports is that the location in the active frequency band is determined by the intensity of the static magnetic field. There have been many attempts to explain this phenomenon but none has been universally accepted. However, it is clear that if a biological response depends on the static magnetic field intensity, and even its orientation with respect to an oscillating field, then the conditions necessary to reproduce the phenomenon are very specific and might easily escape detection (cf. Blackman and Most, 1993). The consequences of these results are that there may be exposure situations that are truly detrimental (or beneficial) to organisms but that are insufficiently common on a large scale that they would not be observed in epidemiological studies; they need to be studied under controlled laboratory conditions to determine impact on health and wellbeing".

On July 8, 2015, a court in Toulouse, France, ruled in favor of a woman with the diagnosis "syndrome of hypersensitivity to electromagnetic radiation" and determined her disability to be 85% with substantial and lasting restrictions on access to employment (160).

Possible mechanism of EHS

Based on the scientific literature on interactions of EMF with biological systems, several mechanisms of interaction are possible. A plausible mechanism at the intracellular and intercellular level, for instance, is an interaction via the formation of free radicals or oxidative and nitrosative stress (161–169). A review by Pall (12, 170, 171) provides substantial evidence for a direct interaction between static and time varying electric fields, static and time varying magnetic fields and electromagnetic radiation with voltage-gated calcium channels (VGCCs). The increased intracellular Ca^{2+} produced by such VGCC activation may lead to multiple regulatory responses, including increased nitric oxide levels produced through the action of the two Ca^{2+} /calmodulin-dependent nitric oxide synthases, nNOS and eNOS. In most pathophysiological contexts, nitric oxide reacts with superoxide to form peroxynitrite, a potent nonradical oxidant, which can produce radical products, including hydroxyl and NO_2 radicals.

Peroxynitrite is by far the most damaging molecule in our body. Although not a free radical in nature, peroxynitrite is much more reactive than its parent molecules NO and O_2 . The half-life of peroxynitrite is short (10–20 ms), but sufficiently long to cross biological membranes, diffuse one to two cell diameters, and allow significant interactions with most critical biomolecules and structures (cell membranes, nucleus DNA, mitochondrial DNA, cell organelles), and a large number of essential metabolic processes (165). Elevated nitrogen monoxide, formation of peroxynitrite, and induction of oxidative stress can be associated with chronic inflammation, damage of mitochondrial function and structure, as well as loss of energy, e.g. via the reduction of adenosine triphosphate (ATP).

The importance of ATP has been shown for CFS (172) and for stress control (173). Those patients describe the same symptoms as those suffering from CMI. This could indicate similarities in the pathomechanisms. Similar disturbances in neurotransmitter expression had been described both with chronic exposure to EMF (174) and in CMI patients (163, 175).

Redmayne and Johansson (176) published a review considering the evidence for an association between myelin integrity and exposure to low-intensity radiofrequency electromagnetic fields (RF-EMFs) typical in the modern world, pointing to that RF-EMF-exposed animals/humans show: 1) significant morphological lesions in the myelin sheath of rats; 2) a greater risk of multiple sclerosis in a study subgroup; 3) effects in proteins related to myelin production; and 4) physical symptoms in individuals with the functional impairment electrohypersensitivity, many of which are the same as if myelin were affected by RF-EMF exposure, giving rise to symptoms of demyelination. In the latter, there are exceptions; headache is common only in electrohypersensitivity, while ataxia is typical of demyelination but infrequently found in the former group. Overall, evidence from in vivo and in vitro and epidemiological studies suggests an association between RF-EMF exposure and either myelin deterioration or a direct impact on neuronal conduction, which may account for many electrohypersensitivity symptoms. The most vulnerable are likely to be those in utero through to at least mid-teen years, as well as ill and elderly individuals.

Complaints in chronic fatigue syndrome (CFS), fibromyalgia (FM), multiple chemical sensitivity (MCS), posttraumatic stress disorder (PTSD) and Gulf War syndrome (GWS) are almost the same. But the cardinal symptoms are different. Meanwhile, they are summarized as chronic multisystem illnesses (CMI) (175). In all of them, various disturbances of functional cycles have been shown as activation of nitrogen oxide and peroxynitrite,

chronic inflammation by activation of NF- κ B, IFN- γ , IL-1, IL-6, and interaction with neurotransmitter expression (163, 175, 177). We recommend classifying EHS as part of CMI (170, 178) leading to a functional impairment (EHS), but still recognizing that the underlying cause remains only the environment (see Figure 1).

Other diseases that require attention with respect to EMF

There is some evidence that transient electromagnetic fields (dirty electricity), in the kilohertz range on electrical wiring, may be contributing to elevated blood sugar levels among diabetics and pre-diabetics. In an electromagnetically clean environment, Type 1 diabetics required less insulin and Type 2 diabetics had lower levels of plasma glucose. Dirty electricity, generated by electronic equipment and wireless devices, is ubiquitous in the environment. Exercise on a treadmill, which produced dirty electricity, increased plasma glucose. These findings may explain why brittle diabetics have difficulty regulating blood sugar. Based on estimates of people who suffer from symptoms of electrohypersensitivity (3%–35%), as many as 5–60 million diabetics worldwide may be affected (179).

The Bioinitiative Report 2012 (10) concluded: Fetal (in-utero) and early childhood exposures to cell phone radiation and wireless technologies in general may be a risk factor for hyperactivity, learning disorders and behavioral problems in school. Common sense measures to limit both ELF-EMF and RF EMF in these populations is

needed, especially with respect to avoidable exposures like incubators that can be modified; and where education of the pregnant mother with respect to laptop computers, mobile phones and other sources of ELF-EMF and RF EMF are easily instituted.

This section deserves special attention in order to respond timely to the rapid technological development leading to more and more complex EMF exposures.

Recommendations for action

EUROPAEM has developed guidelines for differential diagnosis and potential treatment of EMF-related health problems with the aim to improve/restore individual health outcomes and to propose strategies for prevention.

Evidence of treatment strategies for EMF-related illness including EHS

There are only a few studies assessing evidence-based therapeutic approaches to EHS. The interdisciplinary based assessing and counseling of EHS in the Swiss environmental pilot project performed in 2001 showed in an evaluation interview half a year after counseling, that 45% of persons with EHS had benefitted from realizing certain advice, for example, changing the bedroom (128, 129).

In the 2005 Swiss questionnaire study of physicians working with complementary therapeutic tools, two-thirds chose exposure reduction as a principal tool,

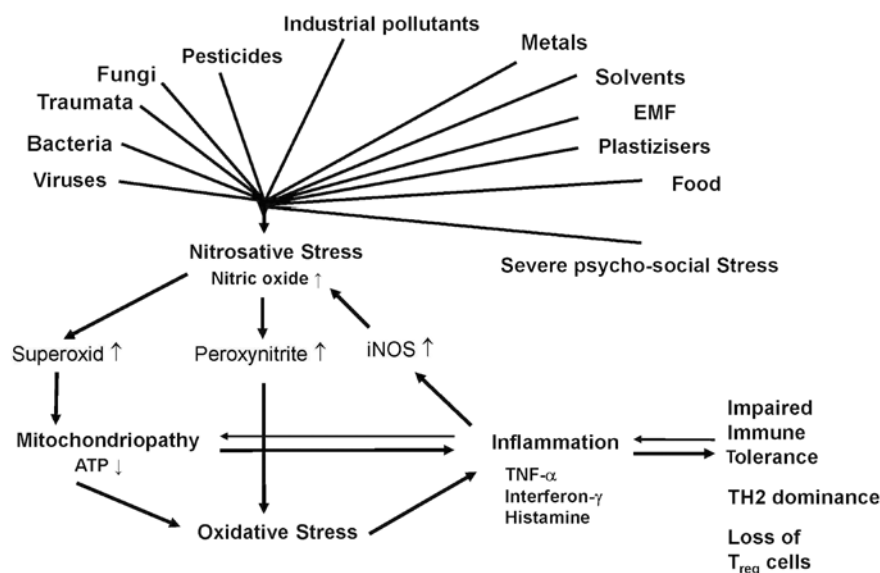


Figure 1: Pathogenesis of inflammation, mitochondriopathy, and nitrosative stress as a result of the exposure to trigger factors (177).

whereas complementary therapeutics were only chosen as a supplement (132).

Since 2008, the Swiss Society of Doctors for the Environment has run a small interdisciplinary environmental medicine counseling structure for persons with EHS, which is embedded in everyday practice with a central coordination and consultation office as well as a network of general practitioners interested in environmental medicine who perform environmental medical assessments and consultations based on a standard protocol. If necessary, environmental experts are consulted and home inspections are conducted. The aim of the assessments is to detect or rule out common diseases and to analyze the impact of suspected environmental burdens on the complaints in order to find individual therapeutic approaches. The main instrument of the assessment is an extensive medical and psycho-social history with an additional environmental history, including a systematic questionnaire and environmental key questions.

In the first years, the project was scientifically assessed. In a questionnaire one year after counseling, 70% of the persons recommended the interdisciplinary-based counseling structure and 32% of them considered the counseling as being helpful. Therefore, a model based on such an interdisciplinary concept, embedded in the family doctor's holistic and lasting concept of treatment, seems to be promising for a better therapeutic approach to EHS, also including accessibility measures targeted at the actual environment (180).

In Finland, psychotherapy is the officially recommended therapy of EHS. In a questionnaire study of EHS people in Finland, symptoms, perceived sources and treatments, the perceived efficacy of medical and complementary alternative treatments (CAM) in regards to EHS were evaluated by multiple choice questions. According to 76% of the 157 respondents, the reduction or avoidance of EMF helped in their full or partial recovery. The best treatments for EHS were given as weighted effects: "dietary change" (69.4%), "nutritional supplements" (67.8%), and "increased physical exercise" (61.6%). The official treatment recommendations of psychotherapy (2.6%) were not significantly helpful, or for medication (−4.2%) even detrimental. The avoidance of electromagnetic radiation and fields effectively removed or lessened the symptoms in persons with EHS (181, 182).

The prognosis of certain diseases can be influenced by EMF-reduction. For example, children who have leukemia and are in recovery have poorer survival rates if their ELF magnetic field exposure at home (or where they are recovering) is between 1 mG [0.1 μ T] and 2 mG [0.2 μ T] or above 2 mG [0.2 μ T] in one study, over 3 mG [0.3 μ T] in another study (9).

Response of physicians to this development

In cases of unspecific health problems (see Questionnaire) for which no clearly identifiable cause can be found – beside other factors like chemicals, nonphysiological metals, mold – EMF exposure should, in principle, be taken into consideration as a potential cause or cofactor, especially if the person presumes it.

A central approach for a causal attribution of symptoms is the assessment of variation in health problems depending on time and location and individual susceptibility, which is particularly relevant for environmental causes such as EMF exposure.

Regarding such disorders as male infertility, miscarriage, Alzheimer's, ALS, blood sugar fluctuations, diabetes, cancer, hyperactivity, learning disorders and behavioral problems in school, it would be important to consider a possible link with EMF exposure. This offers an opportunity to causally influence the course of the disease.

How to proceed if EMF-related health problems are suspected

The recommended approach to diagnosis and treatment is intended as an aid and should, of course, be modified to meet the needs of each individual case (see Figure 2).

1. History of health problems and EMF exposure
2. Examination and findings
3. Measurement of EMF exposure
4. Prevention or reduction of EMF exposure
5. Diagnosis
6. Treatment

History of health problems and EMF exposure

In order to put later findings into a larger context, a general medical history is necessary. In the next steps, we focus only on EMF-related health effects.

A questionnaire to take a systematic history of health problems and EMF exposure, compiled by the EUROPAEM EMF Working Group, is available in the Annex of this EMF Guideline.

The questionnaire consists of three sections:

- a) List of symptoms
- b) Variation of health problems depending on time, location, and circumstances
- c) Assessment of certain EMF exposures that can be estimated by questionnaire

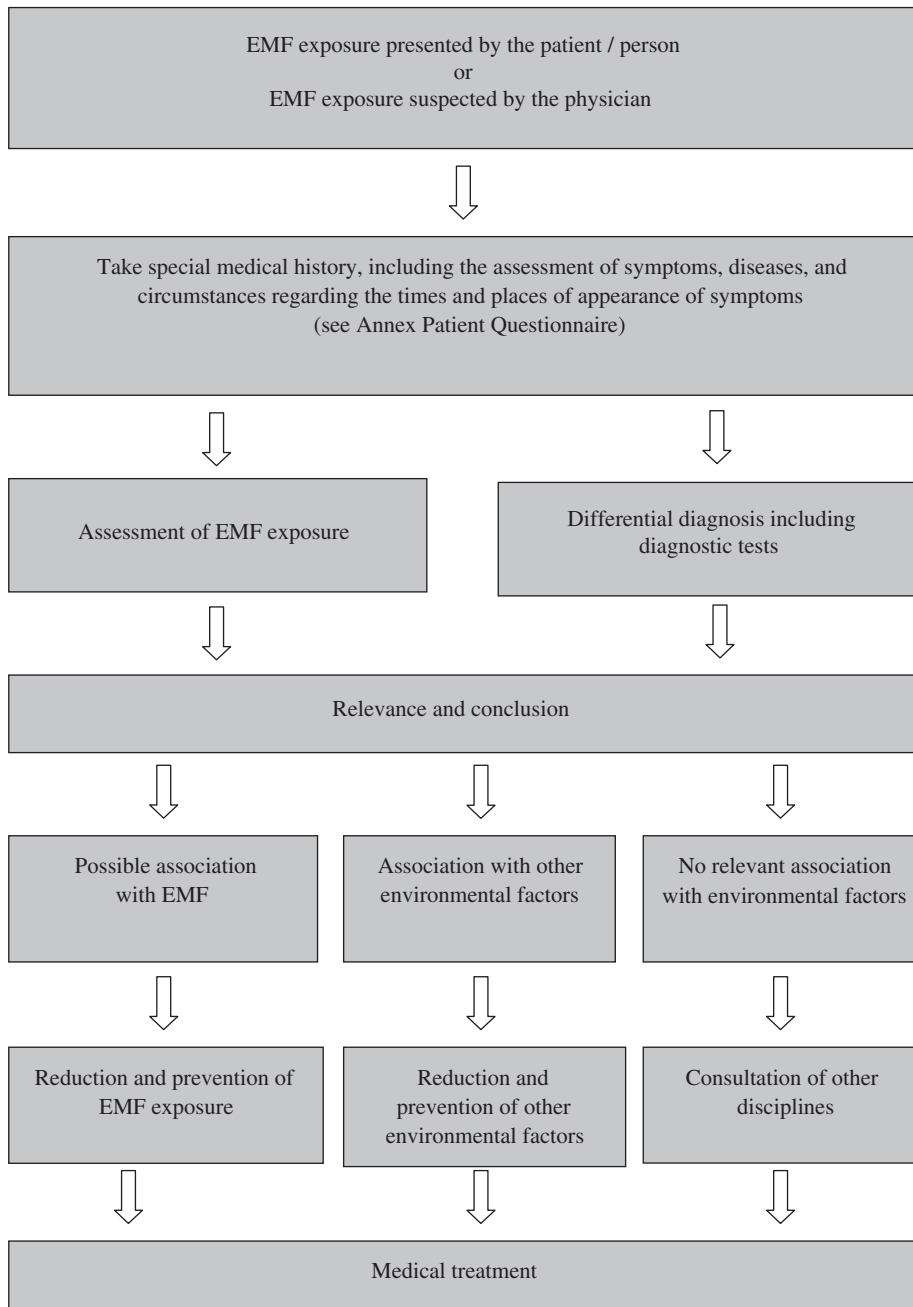


Figure 2: Flowchart for the handling of EMF-related health problems

List of symptoms

The list of symptoms in the questionnaire serves to systematically quantify health problems regardless of their causes. It also includes questions as to when the health problems first occurred. Most EMF-related symptoms are nonspecific and fall within the scope of health problems due to inadequate regulation (decompensation), e.g. sleep problems, fatigue, exhaustion, lack of energy, restlessness, heart palpitations, blood pressure problems, muscle and joint pain, headaches, increased risk for infections, depression, difficulty concentrating,

disturbances of coordination, forgetfulness, anxiety, urinary urgency, anomia (difficulty finding words), dizziness, tinnitus, and sensations of pressure in the head and ears.

The health problems may range in severity from benign, temporary symptoms, such as slight headaches or paresthesia around the ear, e.g. when using a cell phone, or flu-like symptoms after maybe some hours of whole body EMF exposure, to severe, debilitating symptoms that drastically impair physical and mental health. It has to be stressed that, depending on the individual state of

susceptibility, EHS symptoms often occur only occasionally, but over time they may increase in frequency and severity. On the other hand, if a detrimental EMF exposure is sufficiently reduced, the body has a chance to recover and EHS symptoms will be reduced or will vanish.

Variation of health problems depending on time, location, and circumstances

The answers to questions of when and where the health problems occur or recede, and when and where the symptoms increase or are particularly evident, provide only indications. They must be interpreted by the investigator (e.g. regarding the correct attribution between location/EMF sources and health problems). Special attention should be drawn to sleeping areas, because of the duration of influence and the vital role of sleep for regeneration.

Assessment of certain EMF exposures that can be estimated by questionnaire

The assessment of EMF exposure usually starts with certain questions of usual EMF sources. Regardless of whether or not the patient suspects EMF exposure as a cause, these questions should be used to assess the existing exposure level, at least as a rough estimate. It is important to note that only certain types of EMF exposure can be assessed by means of questions, such as the use of compact fluorescent lamps (CFLs), cell phones, and cordless phones. Detection of other types of EMF exposure, e.g. due to RF transmitter sites or the electric or magnetic fields from electric wiring, generally requires measurements. In principle, questions should be asked to assess EMF exposure at home and at work and when on holidays and so on, keeping in mind that the degree of EMF exposure may vary at different times.

Examination and findings

We do not have any clinical findings yet that are specific to EMF, which makes diagnosis and differential diagnosis a considerable challenge.

A method that has proven useful is to use stress-associated findings for diagnosis and followup and to evaluate them synoptically. Basic diagnostic tests should be carried out as a first step, followed by measurements of EMF exposure as a second step. The core diagnosis should focus on investigations of nitric oxide production

(nitrotyrosine), mitochondriopathy (intracellular ATP), oxidative stress-lipid peroxidation (MDA-LDL) and inflammation (TNF-alpha, INF-G (IP-10), IL-1b).

Then additional diagnostic tests can be considered.

Functional tests

Basic diagnostic tests

- Blood pressure and heart rate (in all cases resting heart rate in the morning while still in bed), including self-monitoring, possibly several times a day, e.g. at different locations and with journaling of subjective well-being for a week.

Additional diagnostic tests

- 24-h blood pressure monitoring (absence of nighttime decline)
- 24-h ECG (heart rhythm diagnosis)
- 24-h heart rate variability (HRV) (autonomous nervous system diagnosis)
- Ergometry under physical stress
- Sleep EEG at home

Laboratory tests

Basic diagnostic tests

- Blood
 - Bilirubin
 - Blood count and differential blood count
 - BUN
 - Cholesterol, LDL, HDL, triglycerides
 - Creatinine kinases (CK-MB, CK-MM)
 - CRP
 - Cystatin C (glomerular filtration rate)
 - Electrolytes
 - Fasting blood glucose
 - Ferritin
 - HBA1c
 - Histamine and diaminoxidase (DAO)
 - INF-G (IP-10)
 - Interleukin-1 (e.g. IL-1a, IL-1b)
 - Intracellular ATP
 - Liver enzymes (e.g. ALT, AST, GGT, LDH, AP)
 - Magnesium (whole blood)
 - malondialdehyde-LDL
 - Nitrotyrosine
 - Potassium (whole blood)
 - Selenium (whole blood)
 - TSH
 - Tumor necrosis factor alpha (TNFα)
 - Vitamin D
 - Zinc (whole blood)

- Standard urine
 - Leucocytes, erythrocytes, albumin, urobilinogen, pH, bacteria, glucose, microalbumin
- Second morning urine
 - 6-OH melatonin sulfate
 - Adrenaline
 - Dopamine
 - Noradrenaline
 - Noradrenaline/adrenaline quotient
 - Serotonin
- Saliva
 - Cortisol (8 a.m., 12 a.m., and 8 p.m.)

Additional diagnostic tests

- Urine
 - Metals
- Second morning urine
 - Gamma-aminobutyric acid (GABA)
 - Glutamate
 - Kryptopyrrole
- Saliva
 - Dehydroepiandrosterone DHEA (8 a.m. and 8 p.m.)
- Blood
 - 8-hydroxydeoxyguanosine (DNA oxidation)
 - Biotin
 - Differential lipid profile
 - Folate
 - Holotranscobalamin
 - Homocysteine
 - Interferon-gamma (IFN γ)
 - Interleukin-10 (IL-10)
 - Interleukin-17 (IL-17)
 - Interleukin-6 (IL-6)
 - Interleukin-8 (IL-8)
 - Intracellular glutathione (redox balance)
 - Lactate, pyruvate incl. ratio
 - Lipase
 - NF-kappa B
 - Ubiquinone (Q10)
 - Vitamin B6 (whole blood)

Provocation tests

Special facilities with the use of a variety of signals, e.g. DECT or Wi-Fi exposure (e.g. 20–60 min, depending on the individual regulation capacity, susceptibility, and observed response)

- Heart rate variability (HRV) (autonomous nervous system diagnosis)
- Microcirculation
- Oxidative stress (lipid peroxidation, malondialdehyde-LDL)

Individual susceptibility

- Blood (genetic parameters and actual function)
 - Glutathione S transferase M1 (GSTM1) – detoxification
 - Glutathione S transferase T1 (GSTT1) – detoxification
 - Superoxide dismutase 2 (SOD2) – protection of mitochondria
 - Catechol-O-methyltransferase (COMT) – stress control

Measurement of EMF exposure

The evolutionary development of the human species took place under the presence of the natural electromagnetic spectrum (Earth's magnetic field, Earth's electric field, spherics, Schumann resonance). Those influences have been part of our biosphere like the oxygen content in the air or the visible light spectrum, and they have been integrated into the biological functions.

By now, nearly all nonionizing parts of the electromagnetic spectrum are filled with artificial, technical EMF sources due to electrification and (wireless) communication technologies, but are very rarely found in nature (see Figure 3). EMF measurements and/or exposure damages are usually not covered by statutory health care insurance.

In general, a wide variety of EMF exposure types should be considered: cordless phones (DECT), wireless Internet access (Wi-Fi), electrical wiring and electrical devices in buildings, compact fluorescent lamps (CFLs), mobile phone base stations, radio and TV transmitters, high-voltage power lines or transformer stations, and “dirty electricity”.

In the sleeping area, the most important exposure point is the head and trunk region followed by all other points with chronic or high exposure.

EMF measurements should be planned and carried out by specially trained and experienced testing specialists and always in accordance with relevant standards, e.g. the VDB Guidelines of the German Association of Building Biology Professionals (184). In addition to the measurement results, the measurement report should also include suggestions on how to possibly reduce the EMF exposure.

To clarify certain issues, personal dosimeters with a data logging function are available to measure ELF magnetic fields and radio-frequency radiation.

After the measurements have been commissioned by the person and carried out, the results should be discussed with a physician familiar with the EMF issue.

Electromagnetic spectrum Natural and artificial sources

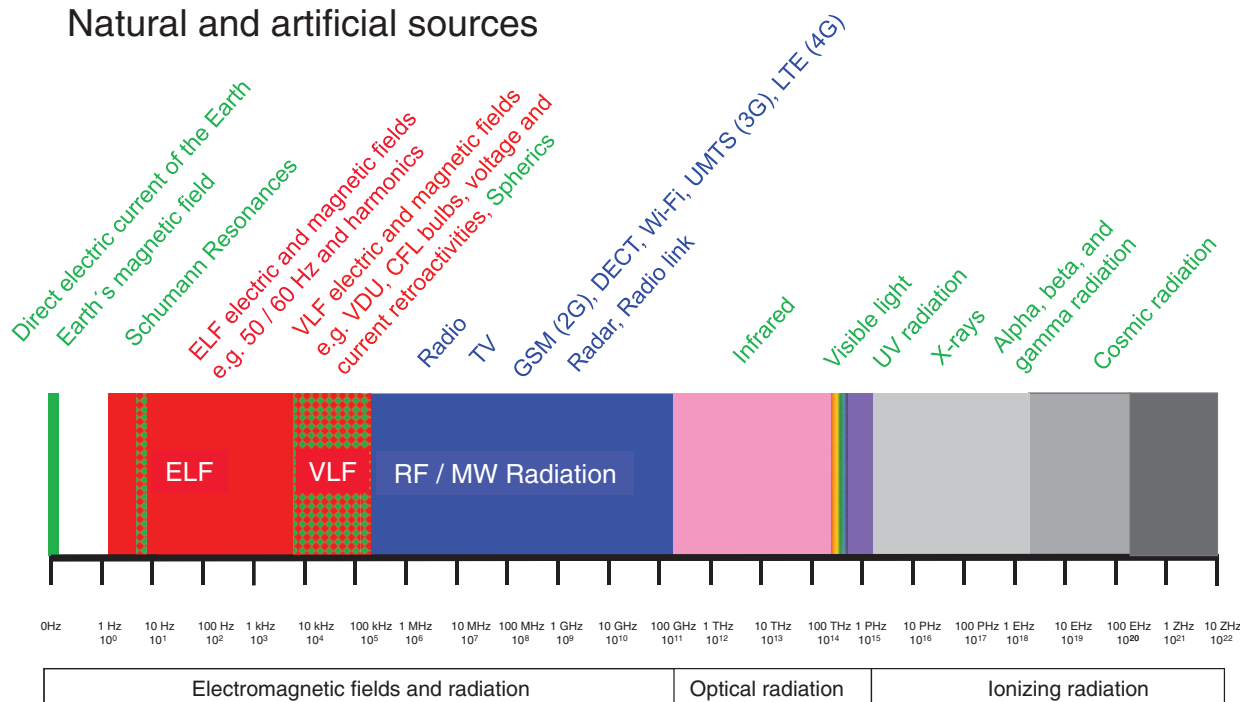


Figure 3: Examples of natural (green) and artificial (red and blue) EMF sources along the electromagnetic spectrum (183).

EMF guidance values

In each case, the following aspects should be individually taken into account when evaluating EMF measurement results (73):

- The person's individual susceptibility
- The person's individual total body burden (e.g. exposure to noise, chemicals)
- Duration of EMF exposure
- EMF exposure during the night and day
- Multiple exposure to different EMF sources
- Signal intensity (W/m^2 , V/m , A/m)
- Signal characteristics (was taken into account in the EMF guidance values – see Supplement 3)
 - Frequency
 - Risetime (ΔT) of bursts, transients, etc.
 - Frequency and periodicity of bursts, e.g. certain GSM base stations (8.3 Hz), Wi-Fi networks (10 Hz), DECT cordless phones (100 Hz)
 - Type of modulation (frequency modulation, amplitude modulation, phase modulation)

Regardless of the ICNIRP recommendations for specific acute effects, the following guidance values apply to sensitive locations with long-term exposure of more than 20 h per week (185). They are based on epidemiological

studies (9, 10, 73, 186–189), empirical observations, and measurements relevant in practice (190, 191) as well as recommendations by the Parliamentary Assembly of the Council of Europe (26). The proposed guidance values are based on scientific data including a preventive component and aim to help restore health and well-being in already compromised patients/functionally impaired persons.

Basic measurements

ELF magnetic fields (extremely low frequency) (ELF MF)

Measurement specifications

Frequency range:	50/60 Hz mains electricity, up to 2 kHz 16.7 Hz railroad systems in Austria, Germany, Switzerland, Sweden, and Norway
Type of measurement:	Magnetic induction or flux density [T; mT; μT ; nT]
Field probe:	Isotropic magnetic field probe (three orthogonal axes)
Detector mode:	RMS (root mean square)
Measurement volume:	Short-term: Bed: Complete sleeping area of bed Short-term: Workplace: Complete working space of workplace (e.g. sitting position) Long-term: e.g. point close to the head/trunk in bed or at workplace

Measurement period:	Short-term measurements to identify field sources Long-term measurements during sleep and work shift
Basis for evaluation:	Long-term measurements: maximum (MAX) and arithmetic mean (AVG)

Precautionary guidance values

In areas where people spend extended periods of time (>4 h per day), minimize exposure to ELF magnetic fields to levels as low as possible or below the precautionary guidance values specified below.

ELF magnetic field	Daytime exposure	Nighttime exposure	Sensitive populations
Arithmetic mean (AVG)	100 nT (1 mG) ^{1),2)}	100 nT (1 mG) ^{1),2)}	30 nT (0.3 mG) ⁴⁾
Maximum (MAX)	1000 nT (10 mG) ^{2),3)}	1000 nT (10 mG) ^{2),3)}	300 nT (3 mG) ⁴⁾

Based on: ¹⁾Biolinitiative (9, 10); ²⁾Oberfeld (189); ³⁾NISV (192);

⁴⁾precautionary approach by a factor 3 (field strength).

Evaluation guidelines specifically for sleeping areas

Higher frequencies than the mains electricity at 50/60 Hz and distinct harmonics should be evaluated more critically. See also the precautionary guidance values for the intermediate frequency range further below. If applicable, mains current (50/60 Hz) and traction current (16.7 Hz) should be assessed separately but added (squared average). Long-term measurements should be carried out especially at nighttime, but at least for 24 h.

ELF electric fields (extremely low frequency) (ELF EF) Measurement specifications

Frequency range:	50/60 Hz mains electricity, up to 2 kHz 16.7 Hz railroad systems in Austria, Germany, Switzerland, Sweden, and Norway
Type of measurement:	Electric field [V/m] without ground reference (potential-free) and/or body-current [A/m ²] see separate paragraph
Field probe:	Isotropic electric field probe (three orthogonal axes)
Detector mode:	RMS (root mean square)
Measurement volume:	Bed: nine points across sleeping area Workplace: Complete working space (e.g. sitting position three or six points)
Measurement period:	Spot measurements to assess the exposure as well as to identify field sources. Since electric field exposure levels in the ELF frequency range usually do not change, long-term measurements are not needed.
Basis for evaluation:	Spot measurements (maximum) at relevant points of exposure

Precautionary guidance values

In areas where people spend extended periods of time (>4 h per day), minimize exposure to ELF electric fields to levels as low as possible or below the precautionary guidance values specified below.

ELF electric field	Daytime exposure	Nighttime exposure	Sensitive populations
Maximum (MAX)	10 V/m ^{1),2)}	1 V/m ²⁾	0.3 V/m ³⁾

Based on: ¹⁾NCRP Draft Recommendations on EMF Exposure Guidelines: Option 2, 1995 (188); ²⁾Oberfeld (189); ³⁾precautionary approach by a factor 3 (field strength).

Evaluation guidelines specifically for sleeping areas

Higher frequencies than the mains electricity at 50/60 Hz and distinct harmonics should be evaluated more critically. See also the precautionary guidance values for the intermediate frequency range further below.

Radio-frequency electromagnetic radiation (RF EMR) Measurement specifications

Frequency range:	Radio and TV broadcast transmitters Mobile phone base stations, e.g. TETRA (400 MHz), GSM (900 and 1800 MHz), UMTS (2100 MHz), LTE (800, 900, 1800, 2500–2700 MHz), Cordless phone base stations, e.g. DECT (1900) Wi-Fi access points and clients (2450 and 5600 MHz) WiMAX (3400–3600 MHz) (above frequencies in MHz refer to European networks)
Type of measurement:	Electric field [V/m] -> calculated power density [W/m ² ; mW/m ² ; μ W/m ²]
Field probe:	Isotropic, biconical, logarithmic-periodic antennas
Detector mode:	Peak detector with max hold
Measurement volume:	Point of exposure across bed and working space
Measurement period:	Usually short-term measurements to identify RF field sources (e.g. acoustic analysis) and peak readings
Basis for evaluation:	Band-specific or frequency-specific spot measurements (peak detector with max hold) of common signals at relevant points of exposure (e.g. with spectrum analyzer or at least band-specific RF meter)

Precautionary guidance values for selected RF sources

In areas where people spend extended periods of time (>4 h per day), minimize exposure to radio-frequency electromagnetic radiation to levels as low as possible or below the

precautionary guidance values specified below. Frequencies to be measured should be adapted to each individual case.

The specific guidance values take the signal characteristics of risetime (ΔT) and periodic ELF “pulsing” into account (191). Note: Rectangular signals show short rise-times and consist of a broad spectrum of frequencies. The body current density increases with increasing frequency in an approximately linear relationship (Vignati and Giuliani, 1997).

RF source Max Peak/Peak Hold	Daytime exposure	Nighttime exposure	Sensitive populations ¹⁾
Radio broadcast (FM)	10,000 $\mu\text{W}/\text{m}^2$	1000 $\mu\text{W}/\text{m}^2$	100 $\mu\text{W}/\text{m}^2$
TETRA	1000 $\mu\text{W}/\text{m}^2$	100 $\mu\text{W}/\text{m}^2$	10 $\mu\text{W}/\text{m}^2$
DVBT	1000 $\mu\text{W}/\text{m}^2$	100 $\mu\text{W}/\text{m}^2$	10 $\mu\text{W}/\text{m}^2$
GSM (2G)	100 $\mu\text{W}/\text{m}^2$	10 $\mu\text{W}/\text{m}^2$	1 $\mu\text{W}/\text{m}^2$
900/1800 MHz			
DECT (cordless phone)	100 $\mu\text{W}/\text{m}^2$	10 $\mu\text{W}/\text{m}^2$	1 $\mu\text{W}/\text{m}^2$
UMTS (3G)	100 $\mu\text{W}/\text{m}^2$	10 $\mu\text{W}/\text{m}^2$	1 $\mu\text{W}/\text{m}^2$
LTE (4G)	100 $\mu\text{W}/\text{m}^2$	10 $\mu\text{W}/\text{m}^2$	1 $\mu\text{W}/\text{m}^2$
GPRS (2.5G) with PTCCH*	10 $\mu\text{W}/\text{m}^2$	1 $\mu\text{W}/\text{m}^2$	0.1 $\mu\text{W}/\text{m}^2$
(8.33 Hz pulsing)			
DAB+	10 $\mu\text{W}/\text{m}^2$	1 $\mu\text{W}/\text{m}^2$	0.1 $\mu\text{W}/\text{m}^2$
(10.4 Hz pulsing)			
Wi-Fi	10 $\mu\text{W}/\text{m}^2$	1 $\mu\text{W}/\text{m}^2$	0.1 $\mu\text{W}/\text{m}^2$
2.4/5.6 GHz (10 Hz pulsing)			

*PTCCH, Packet Timing Advance Control Channel.

Based on: BioInitiative (9, 10); Kundi and Hutter (186); Leitfaden Senderbau (187); Belyaev (73); PACE (26). ¹⁾Precautionary approach by a factor 3 (field strength)=factor 10 power density.

Conversion	mW/m^2	10	1	0.1	0.01	0.001	0.0001
of RF	$\mu\text{W}/\text{m}^2$	10,000	1000	100	10	1	0.1
measurement	$\mu\text{W}/\text{cm}^2$	1	0.1	0.01	0.001	0.0001	0.00001
units	V/m	1.9	0.6	0.19	0.06	0.019	0.006

Additional measurements

Body-current (extremely low frequency) (ELF BC)

The type of body current measurement has been developed in Germany (193) and is used by so-called electrobiologists (194). The methodology offers the possibility to assess directly the relevant effect – the body current – caused by electric and magnetic fields (195). To date, the effects of electric fields on human health with a view to their distribution and relevance to increase the body current density are massively underestimated. We strongly recommend to perform epidemiological studies (e.g. intervention, case-control, cohort) for the health endpoints discussed

and – besides other EMF exposures – to take the following measurements in this order: 1) body current (A/m^2), 2) electric field (V/m) without ground reference (potential-free) without and with a person or a 3D dummy (not grounded!) to simulate the conductive body. In order to distinguish as to whether the measured body currents are caused by electric or magnetic fields, the magnetic fields have to be measured as well in all three axes. Long-term measurements of ELF magnetic fields should be performed with an isotropic magnetic field probe (three orthogonal axes) according to the corresponding paragraph in this chapter.

Measurement specifications

Frequency range:	50/60 Hz mains electricity, up to 2 kHz 16.7 Hz railroad systems in Austria, Germany, Switzerland, Sweden, and Norway
Type of measurement:	Body-current [A/m^2]
Field probe:	Magnetic field probe (one orthogonal axis)
Detector mode:	RMS (root mean square)
Measurement volume:	10 specific points close to the body (head, trunk and limbs)
Measurement period:	Spot measurements to assess the exposure as well as to identify field sources. As electric field exposure levels in the ELF frequency range usually do not change, long-term measurements are not needed.
Basis for evaluation:	Spot measurements (maximum) at relevant points of exposure

Precautionary guidance values

In areas where people spend extended periods of time (>4 h per day), minimize exposure to ELF body-current to levels as low as possible or below the precautionary guidance values specified below.

ELF body-current	Daytime exposure	Nighttime exposure	Sensitive populations
Maximum(MAX)	0.25 $\mu\text{A}/\text{m}^2$ ¹⁾	0.25 $\mu\text{A}/\text{m}^2$ ¹⁾	0.05 $\mu\text{A}/\text{m}^2$ ^{2),3)}

Based on: ¹⁾0.25 $\mu\text{A}/\text{m}^2$ corresponds to 100 nT (RMS, AVG);

²⁾0.05 $\mu\text{A}/\text{m}^2$ corresponds to 20 nT (RMS, AVG), Arbeitskreis Elektrobiologie (194), based on empirical observations; ³⁾precautionary approach by a factor 5 (field strength).

Evaluation guidelines specifically for sleeping areas

Higher frequencies than the mains electricity at 50/60 Hz and distinct harmonics should be evaluated more critically.

See also the precautionary guidance values for the intermediate frequency range further below.

Magnetic fields in the intermediate frequency range (VLF) (IF MF)

Measurement specifications

Frequency range:	3 kHz–3 MHz Frequency-specific measurements (spectrum analyzer/EMF meter), e.g. “dirty power,” powerline communication (PLC), radio-frequency identification transmitters (RFID), compact fluorescent lamps (CFL)
Type of measurement:	Magnetic field [A/m] -> calculated magnetic induction [T; mT; μ T; nT]
Field probe:	Isotropic or anisotropic magnetic field probe
Detector mode:	RMS (root mean square)
Measurement volume:	Point of exposure across bed and working space
Measurement period:	Short-term measurements to identify field sources Long-term measurements during sleep and work shift
Basis for evaluation:	Long-term measurements: RMS detector arithmetic mean and maximum at relevant points of exposure

Precautionary guidance values

In areas where people spend extended periods of time (>4 h per day), minimize exposure to intermediate frequency magnetic fields to levels as low as possible or below the precautionary guidance values specified below.

⁴⁾The body current density increases with increasing frequency in an approximately linear relationship (Vignati and Giuliani, 1997). Therefore, the guidance value of the magnetic field in the intermediate frequency range should be lower than the one of the 50/60 Hz magnetic field, e.g. assuming 100 nT RMS/100=1 nT.

IF magnetic field	Daytime exposure	Nighttime exposure	Sensitive populations
Arithmetic mean	1 nT (0.01 mG) ^{1),2)}	1 nT (0.01 mG) ^{1),2)}	0.3 nT (0.003 mG) ⁴⁾
Maximum	10 nT (0.1 mG) ^{2),3)}	10 nT (0.1 mG) ^{2),3)}	3 nT (0.03 mG) ⁴⁾

Based on: ¹⁾Biolinitiative (9, 10); ²⁾Oberfeld (189); ³⁾NISV (192);

⁴⁾precautionary approach by a factor 3 (field strength).

Electric fields in the intermediate frequency range (VLF) (IF EF)

Measurement specifications

Frequency range:	3 kHz–3 MHz Frequency-specific measurements (spectrum analyzer/EMF meter), e.g. “dirty power,” powerline communication (PLC), radio-frequency identification transmitters (RFID), compact fluorescent lamps (CFL)
Type of measurement:	Electric field [V/m]
Field probe:	Isotropic, biconical, logarithmic-periodic electric field probe
Detector mode:	RMS arithmetic mean
Measurement volume:	Point of exposure across bed and working space
Measurement period:	Short-term measurements to identify field sources Long-term measurements during sleep and work shift
Basis for evaluation:	Long-term measurements: arithmetic mean at relevant points of exposure

Precautionary guidance values

In areas where people spend extended periods of time (>4 h per day), minimize exposure to intermediate frequency electric fields to levels as low as possible or below the precautionary guidance values specified below.

⁴⁾The body current density increases with increasing frequency in an approximately linear relationship (Vignati and Giuliani 1997). Therefore, the guidance value of the magnetic field in the intermediate frequency range should be lower than the one of the 50/60 Hz magnetic field, e.g. assuming 10 V/m RMS arithmetic mean/100=0.1 V/m.

IF electric field	Daytime exposure	Nighttime exposure	Sensitive populations
Arithmetic mean	<0.1 V/m ^{1),2)}	<0.01 V/m ²⁾	<0.003 V/m ³⁾

Based on: ¹⁾NCRP Draft Recommendations on EMF Exposure Guidelines: Option 2, 1995 (188); ²⁾Oberfeld (189); ³⁾precautionary approach by a factor 3 (field strength).

Static magnetic fields

Measurement specifications

Frequency range:	0 Hz
Type of measurement:	Magnetic induction or flux density [T; mT; μ T; nT]

Field probe:	Anisotropic magnetic field probe (for one spatial axis – vertical) or Isotropic magnetic field probe (three orthogonal axes)
Detector mode:	RMS (root mean square)
Measurement volume:	Point of exposure across bed and working space
Measurement period:	Short-term measurements to identify field sources that distort the Earth's magnetic field
Basis for evaluation:	Spot measurements (RMS maximum) at relevant points of exposure

Precautionary guidance values

In areas where people spend extended periods of time (>4 h per day), minimize exposure to static magnetic fields that distort the naturally occurring Earth's magnetic field to levels as low as possible.

Evaluation guidelines specifically for sleeping areas

First determine the natural background level in a reference location, e.g. close to the bed. The field probe must not be moved during the measurement process in order to prevent false readings due to induced currents by the Earth's magnetic field. The guidance values below are meant in addition to the Earth's magnetic field.

Static magnetic field	No anomaly	Slight anomaly	Significant anomaly	Extreme anomaly
Deviation from natural background	$\leq 1 \mu\text{T}$ $\leq 10 \text{ mG}$	$1-2 \mu\text{T}$ $10-20 \text{ mG}$	$2-10 \mu\text{T}$ $20-100 \text{ mG}$	$>10 \mu\text{T}$ $>100 \text{ mG}$

Based on: Building Biology Evaluation Guidelines (SBM-2015) (190), which are based on empirical observations.

Static electric fields

Measurement specifications

Frequency range:	0 Hz
Type of measurement:	Electric field [V/m]
Field probe:	Anisotropic or isotropic electric field probe
Detector mode:	RMS (root mean square)
Measurement volume:	Point of exposure across bed and working space
Measurement period:	Short-term measurements to identify field sources
Basis for evaluation:	Spot measurements (maximum) at relevant points of exposure

Precautionary guidance values

In areas where people spend extended periods of time (>4 h per day), minimize exposure to static electric fields that

exceed the naturally occurring fair-weather atmospheric electric field.

Evaluation guidelines specifically for sleeping areas

Static electric field	No anomaly	Slight anomaly	Significant anomaly	Extreme anomaly
Maximum	$<100 \text{ V/m}$	$100-500 \text{ V/m}$	$500-2000 \text{ V/m}$	$>2000 \text{ V/m}$

Based on: Building Biology Evaluation Guidelines (SBM-2015) (190), which are based on empirical observations.

Prevention or reduction of EMF exposure

Preventing or reducing EMF exposure after consulting a testing specialist is advantageous for several reasons:

- To prevent and reduce risks to individual and public health,
- To identify any links to health problems,
- To causally treat the EMF-related health problems.

There are numerous potential causes of relevant EMF exposures, and this EMF Guideline can only give a few examples. Further information can be found, for instance, in the document "Options to Minimize EMF/RF/Static Field Exposures in Office Environments" (196) and "Elektrosmog im Alltag" (197). For detailed information on physics, properties and measurement of EMF, see Virnich (198); regarding reduction of radio-frequency radiation (RFR) in homes and offices, see Pauli and Moldan (199).

In most cases, it will be necessary to consult an expert (e.g. building biology testing specialist, EMF/RF engineer) and/or electrician who will advise the person on what measures could be taken to reduce EMF exposure.

EMF exposure reduction – First steps

As a first step, it might be useful to recommend to persons that they take certain actions (also as preventive measures) to eliminate or reduce typical EMF exposures, which may help alleviate health problems within days or weeks. The following actions may be suggested:

Preventing exposure to radio-frequency radiation (RFR)

- Disconnect (unplug) the power supply of all DECT cordless phone base stations. So called "ECO Mode" or "zero-emission" DECT phones are only conditionally recommended because the exposure by the handset is

not or not substantially reduced. Therefore, the use of “traditional” corded phones is recommended.

- Disconnect (unplug) the power supply to all Wi-Fi access points or Wi-Fi routers. Many LAN routers now come equipped with additional Wi-Fi. Call the provider of the LAN router and ask to have the Wi-Fi deactivated. It is usually also possible to do so online by following the provider’s instructions.
- Avoid wearing the cell phone/smartphone close to the body.
- Deactivate all nonessential wireless cell phone apps, which cause periodic radiation exposure.
- Keep cell phones/smartphones in “airplane mode” whenever possible.
- In case of external RF radiation sources, rooms – especially sleeping rooms – facing away from the source should be chosen.
- Avoid powerline communication for Internet access (dLAN) and instead use a hardwired Ethernet cable (LAN).
- Avoid exposure to RF radiation (e.g. Bluetooth, Wi-Fi) at home (e.g. home entertainment, headsets), in offices, and in cars.

Preventing exposure to ELF electric and magnetic fields

- Move the bed or desk away from the wiring in the walls and power cords. A minimum distance of 30 cm (1 ft) from the wall is recommended.
- Another simple complementary action is to disconnect the power supply to the bedroom (turn off circuit breaker or fuse) for the nighttime while sleeping; try it for a test phase of, e.g. 2 weeks. In general, this measure is not always successful because circuits of adjacent rooms contribute to the electric field levels. ELF electric field measurements are required to know exactly which circuit breakers need to be disconnected.

The benefits should be weighed against the potential risk of accidents; therefore, the use of a flashlight for the test phase should be recommended.

- Disconnect the power supply to all nonessential electric circuits, possibly in the entire apartment or house. (N.B. See note above.)
- Avoid using an electric blanket during sleep; not only turn it off, but also disconnect it.

Preventing exposure to static magnetic fields

- Sleep in a bed and mattress without metal.
- Avoid to sleep close to iron materials (radiator, steel, etc.)

EMF exposure reduction – second steps

As a second step, EMF measurements and mitigation measures should be carried out. Typical examples are:

- Measure the ELF electric field in the bed or the body current density of the person while in bed. Based on the measurement results, have automatic demand switches in those circuits installed that increase the exposure.
- Measure the ELF electric field at all other places that are used for extended periods at home and at work. If necessary, choose lamps used close to the body with a shielded electric cable and a grounded lamp fixture (metal). Especially in lightweight construction (wood, gypsum board), electrical wiring without grounding (two-slot outlets) might have to be replaced with grounded electrical wiring or shielded electrical wiring. In special cases, the whole building might have to have shielded wiring and shielded outlets installed.
- Measure the ELF magnetic field close to the bed, e.g. for 24 h. If net currents are detected, the electrical wiring and grounding system of the building must be corrected as to reduce the magnetic fields.
- Install a residual current device (RCD) or ground-fault circuit interrupter (GFCI) to prevent electric shocks (safety measure).
- Measure radio-frequency radiation and mitigate high exposure levels by installing certain RF shielding materials for the affected walls, windows, doors, ceilings, and floors.
- Measure dirty electricity/dirty power (electric and magnetic fields in the intermediate frequency range) and identify the sources in order to remove them. If this is not possible, appropriate power filters in line with the source may be used.

Diagnosis

We will have to distinguish between EHS and other EMF-related health problems like certain cancers, Alzheimer’s, ALS, male infertility etc. that might have been induced, promoted, or aggravated by EMF exposure. An investigation of the functional impairment EHS and other EMF-related health problems will largely be based on a comprehensive case history, focusing, in particular, on correlations between health problems and times, places, and circumstances of EMF exposure, as well as the progression of symptoms over time and the individual susceptibility. In addition, measurements of EMF exposure and the results of additional diagnostic tests (laboratory tests, cardiovascular system) serve to support the

diagnosis. Moreover, all other potential causes should be excluded as far as possible.

In 2000 the Nordic Council of Ministers (Finland, Sweden, and Norway) adopted the following ICD-10 code for EHS: Chapter XVIII, Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified, code R68.8 “Other specified general symptoms and signs” (Nordic ICD-10 Adaptation, 2000) (200).

Regarding the current International Classification of Diseases (ICD), ICD-10-WHO 2015, we recommend at the moment:

- a) Electromagnetic hypersensitivity (EHS): to use the existing diagnostic codes for the different symptoms **plus** code R68.8 “Other specified general symptoms and signs” **plus** code Z58.4 “Exposure to radiation” and/ or Z57.1 “Occupational exposure to radiation”.
- b) EMF-related health problems (except EHS): to use the existing diagnostic codes for the different diseases/ symptoms **plus** code Z58.4 “Exposure to radiation” and/or Z57.1 “Occupational exposure to radiation”.

Regarding the next ICD-update (ICD-11 WHO) to be published 2018), we recommend to:

- a) Create ICD codes for all chronic environmentally induced chronic multisystem illnesses (CMI) like multiple chemical sensitivity (MCS), chronic fatigue syndrome (CFS), fibromyalgia (FM), and electromagnetic hypersensitivity (EHS).
- b) Expand Chapter XIX, Injury, poisoning and certain other consequences of external causes (T66-T78) to include/distinguish effects of EMF (static magnetic field, static electric field, ELF magnetic field, ELF electric field, VLF/LF magnetic field, VLF/LF electric field, Radio-frequency electromagnetic radiation) infrared, visible light, UV-light and ionizing radiation.
- c) Expand Chapter XXI, Factors influencing health status and contact with health services (Z00-Z99) to include/ distinguish factors as EMF (static magnetic field, static electric field, ELF magnetic field, ELF electric field, VLF/LF magnetic field, VLF/LF electric field, Radio-frequency electromagnetic radiation), infrared, visible light, UV-light, and ionizing radiation.

Treatment/accessibility measure

The primary method of treatment should mainly focus on the prevention or reduction of EMF exposure that is reducing or eliminating all sources of EMF at home and in the workplace. The reduction of EMF exposure should also be extended to schools, hospitals, public transport, public

places like libraries, etc. in order to enable EHS persons an unhindered use (accessibility measure). Many examples have shown that such measures can prove effective. With respect to total body load of other environmental influences, they must also be regarded.

Beside EMF reduction, other measures can and must be considered. These include a balanced homeostasis in order to increase the “resistance” to EMF. There is increasing evidence that a main effect of EMF on human beings is the reduction of oxidative and nitrosative regulation capacity. This hypothesis also explains observations of changing EMF sensitivity and the large number of symptoms reported in the context of EMF exposure. From the current perspective, it appears useful to recommend a treatment approach, as those gaining ground for multi-system disorders, that aims at minimizing adverse peroxynitrite effects.

It should be stressed, that psychotherapy has the same significance as in other diseases. Products that are offered in the form of plaques and the like to “neutralize” or “harmonize” electrosmog should be evaluated with great restraint.

In summary, the following treatment and accessibility measures appear advantageous, depending on the individual case:

Reduction of EMF exposure

This should include all types of EMF exposures relevant to the person, especially during sleep and at work. For more information, see e.g. “Options to Minimize EMF/RF/Static Field Exposures in Office Environment” (196) and “Elektrosmog im Alltag” (197).

Environmental Medicine treatments

Until now, no specific treatment of EHS has been established. Controlled clinical trials would be necessary to assess optimal treatment and accessibility measures. Actual data indicate that the functional deficits, which can be found in persons with EHS, correspond to those we can find in CMI such as MCS, CFS, and FM. The target of the therapy is the regulation of the physiological dysfunction detected by diagnostic steps (Examination and findings). The main therapeutic target includes both general and adjuvant procedures and specific treatments. The latter are challenging and need special knowledge and experience in clinical environmental medicine treatments. Main therapeutic targets include:

– Control of total body burden

Besides the reduction of EMF exposure, the reduction of the total body burden by various

environmental pollutants (home, working place, school, hobby), food additives, and dental materials is indicated.

– **Reduction of oxidative and/or nitrosative stress**

Reactive oxygen species (ROS) and reactive nitrogen species (RNS) are free radicals naturally produced in cells. Scavengers guarantee the balance between the production of free radicals and the rate of their removal. Many biologically important compounds with antioxidant (AO) function have been identified as endogenous and exogenous scavengers. Among the endogenous AO, we distinguish between enzymatic AO (catalase, glutathione peroxidase, glutathione reductase, superoxide dismutase) and nonenzymatic AO (bilirubin, ferritin, melatonin, glutathione, metallothionin, N-acetyl cysteine (NAC), NADH, NADPH, thioredoxin, 1,4-benzoquinone, ubiquinone, uric acid). They interact with exogenous dietary and/or synthetic AO (carotenoids, retinoids, flavonoids, polyphenols, glutathione, ascorbic acid, tocopherols). The complex regulation and use of these substances is the therapeutic challenge (163, 201).

– **Regulation of intestinal dysfunction**

Endogenous and exogenous scavengers act synergistically to maintain the redox homeostasis. Therefore, dietary or natural antioxidants play an important role to stabilize this interaction.

Treatment of a leaky gut, food intolerance, and food allergy is a prerequisite for maintaining redox homeostasis (202) and also requires special knowledge and experience.

– **Optimizing nutrition**

Bioactive food is the main source of antioxidant components such as vitamin C, vitamin E, NAC, carotenoids, CoQ10, alpha-lipoic acid, lycopene, selenium, and flavonoids (203, 204). For instance, the regeneration of vitamin E by glutathione or vitamin C is needed to prevent lipid peroxidation. The dietary antioxidants only can have beneficial effects on the redox system if they are present in sufficient concentration levels (201). Alpha-lipoic acid acts directly and indirectly as a scavenger of free radicals including peroxynitrite, singlet oxygen, superoxide, peroxy radicals, and the breakdown radicals of peroxynitrite (163). It had been shown that the number of free electrons in micronutrients determines how effective they are. In organic food, the number of free electrons is higher than in conventionally produced food (205). Especially in the case of food intolerances, the tailored substitution of micronutrients in the form of supplements is necessary.

– **Control of (silent) inflammation**

Elevated nitric oxide levels and the reaction with superoxide always leads to elevated peroxynitrate levels, which induce ROS levels as no other substance does (NO/ONOO⁻ cycle). As a result, the nuclear factor κ B (NF- κ B) is activated, inducing inflammatory cytokines such as tumor necrosis factor α (TNF- α), interleukin-1 β (IL-1 β), interleukin-6 (IL-6), interleukin-8 (IL-8), and interferon gamma (IFN γ) and activating various NO synthases (163). Tocopherols (206, 207), carotenoids at low concentration levels (208), vitamin C (209, 210), NAC (211), curcumin (212), resveratrol (213, 214), flavonoids (215) have shown to interrupt this inflammatory cascade at various points.

– **Normalization of mitochondrial function**

Mitochondrial function may be disturbed in two ways. First: the high amount of free radicals may block production of adenosine triphosphate (ATP), leading to muscle pain and fatigue. Second: in the case of silent (smoldering) inflammation, the demand for more energy is elevated by 25% (167), causing a high consumption of ATP. In this case, NADH, L-carnitine and CoQ10 are essential for ATP synthesis.

Due to the lack of ATP, the stress regulation of catecholamines especially norepinephrine (NE) is reduced because catabolism of NE by S-adenosylmethionine is ATP dependent (216–218). Furthermore, stress regulation has a high demand for folate, vitamin B6, and methylcobalamine. Genetic polymorphisms of COMT and MTHFR influence the individual need for those substances (173, 219).

– **Detoxification**

In humans, the accumulation of environmental toxicants has an individual profile of many different inorganic and organic chemicals, which make up the total body load (220).

Among the inorganic substances, metals and their salts play the dominant role and might be of importance to persons with EHS. Elemental mercury (Hg⁰) and other heavy metals such as lead (Pb) accumulate in the brain (221), especially at chronic low dose exposure. They may have toxic effects and can induce various immune reactions (222, 223). Whereas, generally, no specific active substance exists for the detoxification of chemicals, there are two groups of substances with more specific effects that can be used for the detoxification of metals.

1. Substances with nonspecific physiological effects:

Glutathione, NAC, alpha-lipoic acid, vitamin C and selenium.

2. Chelating agents for detoxification of metals (224–226)

The most important chelating agents are:

Sodium thiosulfate 10%

DMPS (2,3-dimercapto-1-propanesulfonic acid)

DMSA (meso-dimercaptosuccinic acid)

EDTA (2,2',2'',2'''-ethane-1,2-diyl dinitrotetraacetic acid)

It should be noted that these substances should be used only by those designated as experts in this particular field.

– Adjuvant therapies

1. Drinking water

For detoxification reasons, a higher intake of high-quality drinking water with low mineral content and no CO₂ is needed. The intake quantity should range from 2.5 to 3.0 L (10–12 8-oz glasses) daily.

2. Light

Most of the people in central and northern Europe are depleted of vitamin D. Sufficient natural daylight exposure during the vitamin D-producing months (spring to fall) is one important factor. At the same time, prevention of actinic damage to the skin is necessary.

3. Sauna

Sauna and therapeutic hyperthermia is an adjuvant therapy for the detoxification of almost all xenobiotics. These therapies have to be carefully used. An interaction with detoxifying drugs takes place. Sauna helps to regenerate tetrahydrobiopterin from dihydrobiopterin, which is essential for the metabolism of catecholamines and serotonin (163).

4. Oxygen

A part of persons with EHS suffer from mitochondrial dysfunction. Sufficient natural oxygen is helpful. As both hypoxia and hyperbaric oxygen can produce oxidative stress, hyperbaric oxygen therapy should only be performed if the persons are treated with sufficient antioxidants at the same time.

5. Exercise

The optimal amount of exercise is still being debated. A person's physical capacity should be assessed by ergometry in order to prescribe an individual exercise regime. Environmental medicine experience indicates that for sick people only low-impact aerobic exercise should be used. In general, start with a work load of

20–30 watts that often can be finished at 60–70 watts. Exercise on an ergometer allows better control of the consumption of energy compared to walking or running. No fatigue should result from exercising, at least after half an hour.

6. Sleep

Sleeping disorders are very common in persons with EHS. Sleep disturbance is associated with reduced melatonin level. In the case of chronic inflammation, the activation of IDO (indolamine-2,3-dioxygenase) reduces the production of serotonin and, in turn, it also reduces melatonin levels. EMF exposure might block the parasympathetic activity while sympathetic activity persists. Concerning sleep disturbances, any therapy has to follow the pathogenic causes. Optimal sleep is necessary to save energy and to regulate the functions of the immune and neuroendocrine systems.

7. Protection from blue light

Wavelengths of visible light below 500 nm are called “blue light”. Low doses of blue light can increase feelings of well-being, but larger amounts can be harmful to the eyes. In natural daylight, the harmful effects of “blue light” are balanced out by the regenerative effect of the red and infrared content. The escalating use of electronic light sources – such as fluorescent tubes and compact fluorescent lamps (CFL), computer screens, laptops, tablets, smartphones, and certain LED bulbs – has increased our exposure to “blue light”, which at this level is suspected of playing a role in the development of age-related macular degeneration and circadian misalignment via melatonin suppression, which is associated with the increased risk of sleep disturbance, obesity, diabetes mellitus, depression, ischemic heart disease, stroke, and cancer. Extended exposure to artificial “blue light” in the evening should therefore be limited. Antioxidants, especially melatonin (227, 228) and blue light screen filters (229–231) could be helpful.

Dental medicine

Dental medicine still works with toxic or immunoreactive materials, e.g. mercury, lead oxide, gold, and titanium. Environmental dental medicine demands that these materials not be used (232–235). The removal of toxic dental materials must take place under maximum safety conditions (avoid inhalation!). The elimination of particularly heavy metals from the body might be indicated. In general

terms, endoprosthetic materials should be inert with respect to immunoreactivity. Based on our current knowledge, zirconium dioxide seems to be a neutral material. However, mechanical abrasion of the coated surface by the dentist should be avoided.

Immunotoxic metals show a similar pathophysiology with respect to oxidative stress, mitochondriopathy, and inflammation.

Lifestyle coaching

Lifestyle coaching may include balanced exercise, nutrition, reduction of addictive substances, change of sleeping habits, etc. and stress reduction measures (reduction of general stress and work stress), as well as methods to increase stress resistance via, e.g. autogenic training, yoga, progressive muscle relaxation, breathing techniques, meditation, tai chi, and qigong.

Treatment of symptoms

A well-balanced treatment of symptoms is justified until the causes have been identified and eliminated. However, it is of paramount importance to realize that the reduction of symptoms may put the person at risk for an increased environmental EMF-load, thus generating possible future, long-term health effects, including neurological damage and cancer. It is a very difficult ethical task for the physician to risk such, and they must be pointed out – in an equally well-balanced way – to the patient in question. Ethically, to treat the symptoms is, of course, a very good start in the immediate sense but without a parallel environmental exposure reduction and lifestyle coaching it may prove counter-productive in the long run. For a standardly trained physician this might seem a very new way of reasoning, but is the only way to a successful and everlasting symptom alleviation and complete clinical remedy when dealing with chronic multisystem illnesses (CMI) and EHS.

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Scientific Panel on Electromagnetic Field Health Risks: Consensus Points, Recommendations, and Rationales

Scientific Meeting: Seletun, Norway, November 17-21, 2009

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Summary: In November, 2009, a scientific panel met in Seletun, Norway, for three days of intensive discussion on existing scientific evidence and public health implications of the unprecedented global exposures to artificial electromagnetic fields (EMF). EMF exposures (static to 300 GHz) result from the use of electric power and from wireless telecommunications technologies for voice and data transmission, energy, security, military and radar use in weather and transportation. The Scientific Panel recognizes that the body of evidence on EMF requires a new approach to protection of public health; the growth and development of the fetus, and of children; and argues for strong preventative actions. New, biologically-based public exposure standards are urgently needed to protect public health worldwide.

Keywords: EMF, wireless telecommunications technology, radiofrequency, non-ionizing radiation, non-thermal effects, long-term effects, public exposure guidelines, public health

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BACKGROUND

In November, 2009, a scientific panel met in Seletun, Norway, for three days of intensive discussion on existing scientific evidence and public health implications of the unprecedented global exposures to artificial electromagnetic fields (EMF).

EMF exposures (static to 300 GHz) result from the use of electric power and from wireless telecommunications technologies for voice and data transmission, energy, security, military and radar use in weather and transportation.

The Scientific Panel recognizes that the body of evidence on EMF requires a new approach to

protection of public health; the growth and development of the fetus, and of children; and argues for strong preventative actions. These conclusions are built upon prior scientific and public health reports /1-6/ documenting the following:

- 1) *Low-intensity (non-thermal) bioeffects and adverse health effects are demonstrated at levels significantly below existing exposure standards.*
- 2) *ICNIRP and IEEE/FCC public safety limits are inadequate and obsolete with respect to prolonged, low-intensity exposures.*

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3) *New, biologically-based public exposure standards are urgently needed to protect public health world-wide.*

4) *It is not in the public interest to wait.*

Strong concern has been voiced by the public, and by scientists as well as public health and environmental policy experts, that the deployment of technologies that expose billions of people worldwide to new sources of EMF may pose a pervasive risk to public health. Such exposures did not exist before the “age of industry and information”. Prolonged exposure appears to disrupt biological processes that are fundamental to plant, animal and human growth and health. Life on earth did not evolve with biological protections or adaptive biological responses to these EMF exposures. Exceptionally small levels of EMF from earth and space existed during the time that all life evolved on earth on the order of less than a billionth to one ten-billionth of a Watt per meter squared. A rapidly accumulating body of scientific evidence of harm to health and well-being constitute warnings that adverse health effects can occur with prolonged exposures to very low-intensity EMF at biologically active frequencies or frequency combinations.

The Seletun Scientific Panel has adopted a Consensus Agreement that recommends preventative and precautionary actions that are warranted now, given the existing evidence for potential global health risks. We recognize the duty of governments and their health agencies to educate and warn the public, to implement measures balanced in favor of the Precautionary Principle, to monitor compliance with directives promoting alternatives to wireless, and to fund research and policy development geared toward prevention of exposures and development of new public safety measures.

POINTS OF AGREEMENT

- Global populations are not sufficiently protected from electromagnetic fields (EMF)

from emerging communication and data transmission technologies that are being deployed worldwide, affecting billions of people;

- Sensitive populations (for example, the elderly, the ill, the genetically and/or immunologically challenged) and children and fetuses may be additionally vulnerable to health risks; their exposures are largely involuntary and they are less protected by existing public safety standards;
- It is well established that children are more vulnerable to health risks from environmental toxins in general;
- It is established that the combined effects of chemical toxins and EMF together is greater than either exposure alone;
- The Seletun Scientific Panel takes note of international scientific reviews, resolutions and recommendations documenting scientific and public health evidence on EMF exposures;
- The Seletun Scientific Panel notes that complete “*consistency*” of study findings is not to be expected, and it should not be interpreted as a necessary pre-condition for a consensus linking EMF exposure to health impacts. “*Consistency in nature does not require that all or even a majority of studies find the same effect. If all studies of lead showed the same relationship between variables, one would be startled, perhaps justifiably suspicious*” /7/;
- The Seletun Scientific Panel acknowledges that some, but not all, of these exposures support preventative and precautionary action, and the need for more stringent public health limits;
- The Panel takes note of international scientific resolutions and expressions of concern including the Salzburg, Catania, Freiburger Appeal, Helsinki, Irish Doctors (IDEA), Benevento, Venice, London, and Porto Alegre Resolutions (2000-2009);
- The Panel is guided by previously recommended target limits for EMF exposure

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in the BioInitiative Report (2007) and the London Resolution (2009);

- The Panel urges governments to adopt an explicit statement that “the standard for judging and acting on the scientific evidence shall be based on prudent public health planning principles rather than scientific certainty of effect (causal evidence)”. Actions are warranted based on limited or weak scientific evidence, or a sufficiency of evidence – rather than a conclusive scientific evidence (causation or scientific certainty) where the consequence of doing nothing in the short term may cause irreparable public health harm, where the populations potentially at risk are very large, where there are alternatives without similar risks, or where the exposures are largely involuntary;
- The Seletun Scientific Panel urges governments to make explicit that the burden of proof of safety rests with the producers and providers of EMF-producing technologies, not with the users and consumers.

**THE SELETUN SCIENTIFIC PANEL
UNANIMOUSLY ENDORSES THESE GENERAL
AGREEMENTS AND GENERAL AND SPECIFIC
RECOMMENDATIONS**

General Agreements from the Seletun Scientific Panel

- The Seletun Scientific Panel has identified specific scientific and public health benchmarks for numeric limits and preventative action that are justified now based on the existing body of evidence;
- The Panel is relying on scientific evidence as the basis for identifying scientific benchmarks establishing EMF levels associated with adverse health effects. The Panel notes that radiofrequent (RF) levels in some regions may

already exceed scientific benchmarks for health harm identified here, but political expediency is not the guiding criterion in this assessment;

- EMF exposures should be reduced now rather than waiting for proof of harm before acting. This recommendation is in keeping with traditional public health principles, and is justified now given abundant evidence that biological effects and adverse health effects are occurring at exposure levels many orders of magnitude below existing public safety standards around the world;
- SAR (Specific Absorption Rate) is not an adequate approach to predict many important biologic effects in studies that report increased risks for cancer, neurological diseases, impairments to immune function, fertility and reproduction, and neurological function (cognition, behaviour, performance, mood status, disruption of sleep, increased risk for auto collisions, etc);
- SAR fails to adequately address known effects from modulation.

General Recommendations from the Seletun Scientific Panel

- The Seletun Scientific Panel recommends an international registry be established to track time-trends in incidence and mortality for cancers and neurological and immune diseases. Tracking effects of EMF on children and sensitive EHS populations is a high priority. There should be open access to this information;
- The Panel recommends existing brain tumour registries provide timely age-specific incidence rates. An early indication of brain tumors from mobile (cell) phone use could be in the younger age-specific incidence rates. Where such brain tumors registries to not exist, they should be established;

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- Intervention-related epidemiological studies are needed to track the efficacy of intervention(s) that reduce or eliminate exposures to EMF;
- There is a need for mandatory pre-market assessments of emissions and risks before deployment of new wireless technologies. There should be convincing evidence that products do not cause health harm before marketing;
- For occupational exposures, there has been epidemiological evidence as well as clusters and case reports which state the 'case for action' and stringent control measures based on classic industrial hygiene principles (separation, distancing and enclosure). Further, there is need for surveillance markers of hematologic, immunotoxic and chromosome aberrations;
- The Panel discourages use of more lenient safety standards for workers, as compared to the general public. Separate safety limits are not ethically acceptable. Workers include women of childbearing age and men who wish to retain their fertility. Occupational environments where wireless exposures are common may be potentially hazardous to fertility and reproduction (retail and restaurant workers, transit workers, telecommunications and broadcast workers, medical workers, educators, administrators, etc) and those with other exposures or special health risks;
- The Panel strongly recommends that persons with electrohypersensitivity symptoms (EHS) be classified as functionally impaired rather than with 'idiopathic environmental disease' or similar indistinct categories. This terminology will encourage governments to make adjustments in the living environment to better address social and well-being needs of this subpopulation of highly sensitive members of society.

General Research Recommendations from the Seletun Scientific Panel

- Research funding is urgently needed for assays for biological markers [*EMF bioassays as biological markers of EMF dose*] which show promise to measure adverse health effects, and biological effects that, with prolonged or repetitive exposure, can reasonably be presumed to lead to harmful health consequences (biomarkers from cerebrospinal fluid, saliva, immune function changes, and DNA damage to name some);
- The Scientific Panel recommends research funding for studies on bioactive modulation which may, based on current knowledge, cause major consequences at far lower exposure levels based on different exposure parameters including modulation, frequency windows, intensity windows, duration, geomagnetic field and other factors;
- Research is urgently recommended for effects of prolonged or repetitive wireless exposure on children (cancers, neurological diseases, and impairment of cognition, behavior, performance and mood status, and disruption of sleep, etc) ;
- Research in SAR refinements is given a low priority. The scientific panel is in unanimous agreement that SAR is a poor measurement tool. Yet SARs have been used in many key studies reporting increased risk of DNA damage, increased risk for brain cancer, increased risk for acoustic neuroma, and reduced sperm quality parameters, among others. SAR measures only one aspect of exposure and ignores other critical aspects, such as biologically active frequencies (and modulations) that is essential information needed to understand the biological responses induced by EMF over short and long term exposures (e.g., nervous system response and

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tissue/organ development, respectively) that does not cause thermal damage so that effective, biologically protective limits can be developed.

Specific Recommendations from the Seletun Scientific Panel

Extremely Low Frequency (Fields from Electrical Power)

- Based on the available evidence, the Seletun Scientific Panel recommends a 0.1 uT (1 mG) exposure limit for all new installations based on findings of risk for leukemia, brain tumours, Alzheimer's, ALS, sperm damage and DNA strand breaks. This exposure limit does not include a safety margin;
- For all newly installed, or newly upgraded electrical power distribution, the Panel recommends a 0.1 uT (1 mG) set-back distance, from residences, hospitals, schools, parks, and playgrounds schools (and similar locations occupied by children) [A 0.1 uT (1 mG) time-weighted average (TWA) using peak loading for transmission lines to ensure that average is about half of this for typical exposures; or equivalent for long-term exposure in interior EMF environments (wiring, trans-formers, appliances, others).];
- For all newly constructed residences, offices, schools (and other facilities with children), and hospitals there shall be a 0.1 uT (1 mG) max. 24 hour average exposure limit;
- For all new equipment (e.g. transformers, motors, electronic products), where practical, the Panel recommends a 0.1 uT (1 mG) max. 24 hour average exposure limit. Where not practical (e.g. large power transformers), there should be a fence, or boundary marker, with clearly written warning labels that states that within the boundary area the 0.1 uT (1 mG) maximum, 24 hour average exposure limit is exceeded;

- The Panel recommends all countries should adopt electrical code requirements to disallow conduction of high-frequency voltage transients back into electrical wiring systems;
- All new electronic devices including compact fluorescent lamps (CFLs) should be constructed with filters to block high-frequency voltage transients from being conducted back onto electrical wiring systems;
- The Panel recommends electric field reductions from electrical wiring in buildings based on evidence of increased cancer risk from prolonged or repetitive electric field exposure. The United States National Electrical Code (NEC) and other governmental codes relating to building design and construction should be revised so that all new electrical wiring is enclosed in a grounded metal shield;
- The United States NEC and other governmental codes that disallow net current on electrical wiring should be better enforced, and ground fault interrupters (GFIs) should be installed on all electrical circuits in order to reduce net current.

Radiofrequency/Microwave Radiation Exposure Limit Recommendations

Present guidelines, such as IEEE, FCC, and ICNIRP, are not adequate to protect humans from harmful effects of chronic EMF exposure. The existing scientific knowledge is, however, not sufficient at this stage to formulate final and definite science-based guidelines for all these fields and conditions, particularly for such chronic exposure as well as contributions of the different parameters of the fields, e.g. frequency, modulation, intensity, and window effects. The values suggested below are, thus, provisional and may be altered in the future.

- For whole-body (in vivo experiments) or cell culture-based exposure, the Seletun Scientific Panel finds sufficient evidence to establish a

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scientific benchmark for adverse health effect at 0.0166 W/kg based on at least 32 scientific studies reporting low-intensity effects (defined as studies reporting effects at exposures of 0.1 W/kg or lower) /8-39/.

- The Panel recommends a provisional whole-body limit of 0.00033 W/kg by incorporation of an additional 50-fold safety margin applied to the scientific benchmark of 0.0166 W/kg. This is consistent with both ICNIRP and IEEE/FCC safety factors. An additional 10-fold reduction is applied to take prolonged exposure into account (because 29 of the 32 studies are acute exposure only), giving a final whole-body limit of 0.000033 W/kg (33 μ W/kg). No further safety margin or provision for sensitive populations is incorporated. This may need to be lowered in the future.
- Based on power density measurements, the Seletun Scientific Panel finds sufficient evidence for a whole-body scientific benchmark for adverse health effect exists down to 85 mW/m² (0.0085 mW/cm² or 8.5 μ W/cm²) based on at least 17 scientific studies reporting low-intensity effects on humans. Taking more recent human studies conducted near base stations, or at base-station RF levels, Kundi and Hutter /57/ report that the levels must exceed 0.5-1.0 mW/m² (0.05 to 0.1 μ W/cm²) for effects to be seen; /40-57/.
- The Panel recommends a provisional whole-body (far-field) limit of 1.7 mW/m² (also = 0.00017 mW/cm² = 0.17 μ W/cm²) by incorporation of an additional 50-fold safety margin applied to the scientific benchmark of 85 mW/m². This is consistent with both ICNIRP and IEEE/FCC safety factors. This may need to be lowered in the future.
- It can be argued that a further 10-fold reduction is not justified since 13 of the 17 studies are already testing for long-term RF exposure. However, considering that the latest human population studies as reported by Kundi & Hutter (2009) do not show effects

below 0.5-1.0 mW/m², it can also then be argued that an additional 10-fold reduction on precautionary grounds is justified. If another 10-fold reduction is applied, the recommended level would then be 0.17 mW/m² (also 0.000017 mW/cm² = 0.017 μ W/cm²);

- The Seletun Scientific Panel recommends these numeric limits to governments and health agencies for adoption in place of ICNIRP, IEEE/FCC and other outdated public safety guidelines and limits in use around the world. This approach is based on traditional public health principles that support taking actions to protect public health when sufficient evidence is present. Sufficient scientific evidence and public health concern exist today based on increased risk for cancer, adverse fertility and reproductive outcomes, immune disruption, neurological diseases, increased risk of road collisions and injury-producing events, and impairment of cognition, behaviour, performance, mood status, and disruption of sleep;
- Numeric limits recommended here do not yet take into account sensitive populations (EHS, immune-compromised, the fetus, developing children, the elderly, people on medications, etc). Another safety margin is, thus, likely justified further below the numeric limits for EMF exposure recommended here;
- The Scientific Panel acknowledges that numeric limits derived here for new biologically-based public exposure standards are still a billion times higher than natural EMF levels at which all life evolved.

Specific Recommendations for mobile (cell) and cordless phone use

- The Seletun Scientific Panel recommends that users keep mobile (cell) phones away from head and body;
- The Seletun Scientific Panel recommends that users keep mobile (cell) phones and PDAs* switched off if worn or carried in a pocket or

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holster, or on a belt near the body.

*PDA is generic for any type of Personal Digital Assistant or hand-held computer device;

- The Panel strongly recommends against the use of mobile (cell) and cordless phones and PDAs by children of any age;
- The Panel strongly recommends against the use of mobile (cell) and cordless phones and PDAs by pregnant women;
- The Panel recommends that use of mobile (cell) and cordless phones and PDAs be curtailed near children or pregnant women, in keeping with preventative and precautionary strategies. The most vulnerable members of society should have access to public places without fear of harm to health;
- Public access to public places and public transportation should be available without undue risk of EMF exposure, particularly in enclosed spaces (trains, airplanes, buses, cars, etc) where the exposure is likely to be involuntary;
- The Panel recommends wired internet access in schools, and strongly recommends that schools do not install wireless internet connections that create pervasive and prolonged EMF exposures for children;
- The Panel recommends preservation of existing land-line connections and public telephone networks;
- The Panel recommends against the use of cordless phones (DECT phones) and other wireless devices, toys and baby monitors, wireless internet, wireless security systems, and wireless power transmitters in SmartGrid-type

connections that may produce unnecessary and potentially harmful EMF exposures;

- The Panel recognizes that wired internet access (cable modem, wired Ethernet connections, etc) is available as a substitute;
- The Panel recommends use of wired headsets, preferably with hollow-tube segments;
- The Panel recommends avoidance of wireless (Bluetooth-type) headsets in general;
- The Panel encourages the removal of speakers from headsets on wireless phones and PDAs;
- The Panel encourages 'auto-off switches' for mobiles (cells) and PDAs that automatically turn off the device when placed in a holster;
- The Panel strongly discourages the technology that allows one mobile (cell) phone to act as a repeater for other phones within the general area. This can increase exposures to EMF that are unknown to the person whose phone is "piggy-backed" upon without their knowledge or permission;
- The Panel recommends the use of telephone lines (land-lines) or fiber optic cables for SmartGrid type energy conservation infrastructure. Utilities should choose options that do not create new, community-wide exposures from wireless components of SmartGrid-type projects. Future health risks from prolonged or repetitive wireless exposures of SmartGrid-type systems may be avoided by using telephone lines or fiber-optic cable. The Panel endorses energy conservation but not at the risk of exposing hundreds of millions of families in their homes to a new, involuntary source of wireless radiofrequency radiation.

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The undersigned recognize the duty of governments and their health agencies to educate and warn the public, to implement measures balanced in favor of the Precautionary Principle, to monitor compliance with directives promoting alternatives to wireless, and to fund research and policy development geared toward prevention of exposure.

The undersigned urge governments and their health agencies to adopt new interim numeric limits and new timetables for implementation of biologically-based precautionary action to limit exposures to EMF.

Agreed 19 November 2009

(as revised through April 20, 2010)

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Organizations; EMF Safety Network Comments, Aug. 30, 2013

**BEFORE THE
FEDERAL COMMUNICATIONS COMMISSION
WASHINGTON, DC. 20554**

In the Matter of

Reassessment of Federal Communications
Commission Radiofrequency Exposure Limits
and Policies

ET Docket No. 13-84

Proposed Changes in the Commission's Rules
Regarding Human Exposure to
Radiofrequency Electromagnetic Fields

ET Docket No. 03-137

COMMENTS OF EMF SAFETY NETWORK

INTRODUCTION AND BACKGROUND:

1. EMF Safety Network ("Network") appreciates this chance to participate in the captioned proceeding. The Federal Communications Commission (FCC) request for comments is in part a response to the US Government Accountability Office¹ (GAO) who called for a review stating, the "*FCC should formally reassess and, if appropriate, change its current RF energy exposure limit and mobile phone testing requirements related to likely usage configurations, particularly when phones are held against the body.*" The GAO also states, "*The Federal Communications Commission's RF energy exposure limit may not reflect the latest research, and testing requirements may not identify maximum exposure in all possible usage conditions.*"

2. The FCC has not updated its radiofrequency (RF, wireless, radiation)

¹Exposure and Testing Requirements for Mobile Phones Should Be Reassessed
<http://www.gao.gov/products/GAO-12-771>

exposure guidelines since 1996. Meanwhile there has been an explosion of wireless devices in homes across America, and forced deployment of radiation on the general population. For example: cell towers, cell and cordless phones, wi-fi, wireless computers and printers, ipads in schools, baby monitors, smart meters, and smart grid.

3. The federal government has taken sole responsibility for the radiation safety of personal wireless service deployment,² leaving local and state jurisdictions powerless to protect the public from non-thermal RF harm. However, no federal agency is acting responsibly, or taking accountability for protecting the public and the environment from the long term effects of exposure to radiation.

4. The telecommunication, utility industries, and utility regulators use the FCC RF guidelines as proof of safety. For example, the California Public Utilities Commission (“CPUC”) stated in D.10-12-001, (Finding of Fact 2): *“All radio devices in PG&E’s Smart Meters are licensed or certified by the FCC and comply with all FCC requirements.”* With this purported proof in hand, they are trampling public rights, and thwarting cities’ efforts and responsibilities to protect their residents and environment. More than a dozen local jurisdictions in California made smart meter installation illegal, yet PG&E continued to force deployment with the support of the CPUC.

5. The FCC, in response³ to a smart meter inquiry from the EMF Safety Network, downplays the need for greater FCC oversight and grossly misconstrues smart meter radiation exposure on our homes, stating, *“the devices normally transmit for less than one second a few times a day and consumers are normally tens of feet or more from the meter face...”* The fact is some people are sleeping within a few feet of smart meters, and PG&E admitted one smart meter could transmit up to 190,000 pulses a day.⁴

6. The FCC has a duty to the public to protect the public health and safety from harm from wireless radiation. The FCC’s failure to protect the health and safety of

²47 U.S.C. § 332(c)(7); 47 C.F.R. 1.1307(b) and 1.1310, which are based on perceived harm of overheating of human tissues by RF radiation.

³ <http://emfsafetynetwork.org/wp-content/uploads/2011/04/FCC-letter-Smart-Meters.pdf>

⁴ http://emfsafetynetwork.org/wp-content/uploads/2011/11/PGERFDataOpt-outalternatives_11-1-11-3p-m.pdf

citizens by providing updated biologically- based RF safety limits on RF exposure goes to the heart of the *Chevron* and *Massachusetts v. EPA* rulings on an agency's authority to disregard its Congressional mandate. Such agency action and inaction are "arbitrary and capricious...[and] otherwise not in accordance with law." (*Massachusetts v. EPA*, 549 U.S. 497, 534-535 (2007)) The statute requiring the FCC to adopt and update RF safety regulations is not ambiguous, and therefore the clear intent of Congress applies."⁵

7. The stated goal of the Notice of Proposed Rulemaking (NRPM) includes "*...the Commission's intent is to appropriately protect the public without imposing an undue burden on the industry...*"

THE PUBLIC IS NOT APPROPRIATELY PROTECTED.

8. Attachment A is a set of declarations from tens of utility customers who state their health and lives have been seriously affected by Smart Meters. Customers declare to suffering health and other safety impacts since the installation of Smart Meters on their homes or in their communities. The following are selected quotes from the declarations.

*"I am experiencing the following symptoms due to the radiation emitted from smart meters: headaches, tinnitus, insomnia, dizziness, nausea, vomiting, depression, and lethargy. My facial skin has also become extremely dry and rough, as if it has been burned...My daughter experiences the following symptoms due to smart meter radiation: chronic bloody noses and occasional headaches."*⁶

"I was unaware that a Smart Meter had been installed on our house, but I suddenly began having severe, debilitating headaches, joint and muscle pain, muscle cramping, elevated blood pressure, irregular heartbeat, insomnia, and an intermittent buzzing/tingling sensation in my legs and feet that happened every few seconds day and night, and I realized on checking with the electric company, that my symptoms began right after the Smart Meter was first installed. What further confirmed for me my suspicion that

⁵Comments of EMR Policy Institute, February 5, 2013, ¶ 43 et seq.

⁶Attachment A: Declaration of Allison Elaine Panelli, see also Declarations of Cynthia Sue Larson, Elizabeth Barris, Ellen Marks, William C. Beckham, Joan Farber

my symptoms were connected to the Smart Meter was the fact that my symptoms completely disappeared when I would go to stay a few days at my daughter's house in Marin County..."⁷

*"Since the installation of SmartMeters in our neighborhood, I have suffered with tinnitus, muscle cramps, sleep disturbance, chronic fatigue, heart palpitations, migraines, blurred vision, and dizziness...When I visit my father in Shasta County who lives in an area where there are no SmartMeters as yet, the tinnitus stops completely. I sleep well and feel much better."*⁸

"A Smart Meter was installed on my home over my objections in August 2010. At first I did not notice any ill effects, but over time symptoms began to accrue. By November 2011 I was suffering from insomnia, nosebleeds while sleeping, constant nausea, headaches, heart palpitations, fatigue, loss of balance, and depression. I called PG&E several times to request removal of the Smart Meter. They refused."⁹

Customers express concern for their health, the health of their children and for others welfare:

*"After 10-15 minutes of exposure to one "Smart Meter" from a distance of 6 feet, I began to experience heart palpitations and felt physical distress so that I had to quickly move away as I feared for my health, the condition of my heart and my very life."*¹⁰

"We fear for the stability of our daughter's health. She is chemically sensitive, which means that her immune system is compromised. Believing, as many medical people do, that sensitivity is probably triggered by an event of overexposure, we do not want to risk another problem."¹¹

"My concerns for the Owner, the residents and my own family are Smart Meter-related fires, privacy invasion, expensive rates, over-billing, hacking of personal information, wiring overloads, dirty electricity, explosions

⁷ Attachment A: Declaration of Carole Jones

⁸ Attachment A: Declaration of Julie Ostoich

⁹ Attachment A: Declaration of Marla June Crites

¹⁰ Attachment A: Declaration of Ellen Kay Cecil

¹¹ Attachment A: Declaration of William George Riggan

and health impacts on all.”¹²

Some customers experience physical suffering, and worsening of health conditions even though they don't have a Smart Meter on their home, but their neighborhood is deployed:

“Since Smart Meters were installed in my neighborhood I have experienced worsened tinnitus and worsened insomnia.”¹³

“Since Smart Meters were installed in my neighborhood, my formerly very mild electrical sensitivity worsened significantly and rapidly. I experience insomnia, frequent headaches, worsened sinus disease, tinnitus, and such cognitive problems as poor short term memory, confusion, and disorganization”.¹⁴

“I do not have a Smart Meter on my home, but I am surrounded by Smart Meters on my neighbors homes...Since Smart Meters were installed in my neighborhood I have experienced constant tinnitus, something I did not have before the meters were installed. I have also experienced otherwise-unexplained sleep disturbances.”¹⁵

“Since the installation of my neighbors' smart meters in mid-2011 (my wife and I opted out of the smart meter program, but we are still affected by the smart meters in our neighborhood) I have suffered from daily heart palpitations, dizziness, headaches, worsened tinnitus, insomnia, and fatigue...”¹⁶

“Since deployment of Smart Meters in my neighborhood in late August, 2010, my symptoms of electrosensitivity have worsened, and I have lost the use of portions of my home and property because I must avoid proximity to neighborhood wireless Smart Meters.”¹⁷

“Since Smart Meters were installed in my neighborhood I have experienced worsened anxiety, terrible headaches, and

¹² Attachment A: Declaration of Tobie B. Cecil

¹³ Attachment A: Declaration of Beverly Filip, see also Declarations of Abram S. Perlstein, Linda Sue Kocsis, Rhonda Hoefs, Nancy Hubert, Sarah Jane Beard

¹⁴ Attachment A: Declaration of Juliene G. Lipson

¹⁵ Attachment A: Declaration of Linda Marie Stedjee

¹⁶ Attachment A: Declaration of Keith James Kocsis

¹⁷ Attachment A: Declaration of Louise Stanphill

heart palpitations.”¹⁸

Some customers have found the Smart Meter system intolerable and have been forced to relocate out of state.

“The effects of the Smart Meter were so debilitating for me that I have relocated to North Carolina, to an area where there are no Smart Meters.”¹⁹

“We have since abandoned our house and California all together and relocated to Ann Arbor, Michigan where, sadly, the meters are now on their way. We are preparing to run again once they get to our neighborhood.”²⁰

Attachment A is a small sample of the types of complaints Network has received. A compilation of hundreds of smart meter health complaints are posted on the EMF Safety Network website.²¹

9. Many other websites are addressing the problem of EMF and wireless radiation harm²², and are opposed to Smart Meters.²³ These websites are further evidence of the amount of global concern over ubiquitous whole body involuntary exposures to radiation and the need for a better protections and a safer environment.

10. In 2011, Network conducted an online survey to investigate the health and safety complaints of Smart Meters. Ed Halteman, PhD Statistics, of Survey Design and Analysis evaluated the results. A true and accurate copy of Mr. Halteman’s Final Results Summary dated September 13, 2011 can be found at [Wireless Utility Meter Safety Impacts Survey Results-Final](http://emfsafetynetwork.org/?page_id=2292). He reported that: “Statistical testing shows the top health symptoms are positively associated with EMF Sensitivity and wireless meters on the home.” Top health symptoms reported since the wireless meters were installed on or near the home (318 people) included sleep problems (49%), stress (43%), headaches (40%), ringing in the ears (38%) and heart problems (26%).

¹⁸Attachment A: Declaration of Zachary Ryan Marks

¹⁹Attachment A: Declaration of Carole Jones

²⁰Attachment A: Declaration of Mary Hankins

²¹Smart Meter Health Complaints http://emfsafetynetwork.org/?page_id=2292

²²Global EMF Websites <http://emfsafetynetwork.org/?p=120>

²³Websites Opposed to Smart Meters http://emfsafetynetwork.org/?page_id=6914

11. International doctors and scientists are warning about wireless radiation risks based on scientific research and are calling for more protective FCC RF guidelines.

- **The BioInitiative 2012 Report:** *“Based on our own research and review of other evidence the existing FCC/IEE and ICNIRP public safety limits and reference levels are not adequate to protect public health. New public health standards and limits are needed.”*²⁴
- **Dr. Ronald M Powell, PhD:** *“The current FCC Maximum Permitted Exposure (MPE) limits are so high that they provide no protection for the public from the biological effects found in any of the 67 studies.” “New biologically based RF exposure limits proposed in the BioInitiative 2012 Report are 1 million times lower than current FCC limits and would protect against the biological effects found in nearly all of the 67 studies.”*²⁵
- **The American Academy of Environmental Medicine:** *“According to the FCC and other regulatory agencies, only thermal effects are relevant regarding health implications and consequently, exposure limits are based on thermal effects only.”*²⁶
- **David Carpenter M.D.:** *“Some effects are shown to occur at several hundred thousand times below the FCC public exposure guidelines, which are set based on the fallacious assumption that there are no adverse health effects at exposures that do not cause easily measureable heating. FCC also only apply to 30-minute public exposures; therefore do not even infer safety at durations >30 minutes, such as in a school setting”.*²⁷

²⁴<http://www.bioinitiative.org>

²⁵Biological Effects from RF Radiation at Low-Intensity Exposure, based on the BioInitiative 2012 Report, and the Implications for Smart Meters and Smart Appliances <http://emfsafetynetwork.org/wp-content/uploads/2013/08/Biological-Effects-From-RF-Radiation-and-Implications-for-Smart-Meters-June-5-2013-2.pdf>

²⁶Electromagnetic and Radiofrequency Fields Effect on Human Health <http://aaemonline.org/emfposition-statement.pdf>

²⁷<http://www.wirelesswatchblog.org/wp-content/uploads/2001/11/Amended-Declaration-of-Dr-David-Carpenter.pdf>

- **Dr. Martin Blank:** *“RF radiation can cause single and double strand DNA breaks at exposure levels that are currently considered safe under the FCC guidelines. There are also epidemiological studies that show an increased risk of cancers associated with exposure to RF.”*²⁸
- **Dr. Magda Havas:** *“The current guidelines for microwave radiation are based on a heating effect of a healthy adult male (as they were originally designed for military personnel working near radar antennas). These guidelines were never designed nor intended to protect children and pregnant women. The guideline in the U.S. is calculated as the average exposure over a 30-minute period that does not raise the body temperature of tissue by 1 degree Celsius. The U.S. has no long-term guidelines and no biological guidelines for microwave radiation. The guidelines in Russia, Switzerland and many other countries are 100 times more protective than those in the United States.”*²⁹
- **Dr. Poki Stewart Namkung:** *“Meeting the current FCC guidelines only assures that one should not have heat damage from SmartMeter exposure. It says nothing about safety from the risk of many chronic diseases that the public is most concerned about such as cancer, miscarriage, birth defects, semen quality, autoimmune diseases, etc. Therefore, when it comes to non thermal effects of RF, FCC guidelines are irrelevant and cannot be used for any claims of SmartMeter safety unless heat damage is involved...”*³⁰
- **Dr. John Wargo Ph.D.,** professor of Environmental Risk and Policy at Yale University *“The scientific evidence is sufficiently robust showing that cellular devices pose significant health risks to children and pregnant women. The weight of the evidence supports stronger precautionary regulation by the federal government.”*³¹
- **Dr. Henry Lai and Blake Levitt:** *“Indeed hundreds of studies have found*

²⁸ http://www.saferemr.com/2013_03_01_archive.html

²⁹ http://www.saferemr.com/2013_03_01_archive.html

³⁰ <http://emfsafetynetwork.org/wp-content/uploads/2009/11/Health-Risks-Associated-With-SmartMeters.pdf>

³¹ [Cell Phones, Technology/ Exposures/Health Effects http://ehhi.org/cellphones/index.shtml](http://ehhi.org/cellphones/index.shtml)

biological/health effects at orders of magnitude below the current FCC thresholds.”³²

12. Other countries have lower RF exposure guidelines and/or have taken steps to advise protective measures for the public. The FCC recognizes the World Health Organization now classifies RF as a 2B carcinogen. Providing literature to the public on how they can protect themselves and their families is an important step.

13. AM Best, an insurance rating company, is warning about financial risks for emerging technologies, including wireless radiation and cyber security risks. They compare the US property/casualty industry asbestos losses at \$85 billion and warn that losses from emerging technologies could be extremely significant.³³

14. **WILDLIFE IS NOT APPROPRIATELY PROTECTED.** Dr. Henry Lai and Blake Levitt submitted comments to the FCC in this proceeding on RF effects on the environment and wildlife.³⁴ Network supports their comments and recommendations.

15. SUGGESTED SOLUTIONS

A. Provide a written public admission that the FCC’s thermal guidelines do not imply or ensure public safety for long-term RF exposures.

B. Provide written public policy that adopts prudent avoidance strategies and directs the public to reduce exposure to wireless devices and use wired alternatives. Include a focus on the protection of children.

C. Create new biologically based safety limits as suggested by the BioInitiative 2012 Report. A precautionary benchmark of .0003 u/Wcm² is a recommended non-thermal level.

D. Post SAR’s on the FCC website, on products and at point-of sale.

E. Tell Congress to fund the EPA for EMF/RF research, and to maintain a RF health and environmental complaints database.

³² <http://apps.fcc.gov/ecfs/document/view?id=7520939733>

³³ AM Best: Emerging Technologies Pose Significant Risks with Possible Long Tail Losses
<http://www.ambest.com/directories/bestconnect/EmergingRisks.pdf>

³⁴ <http://apps.fcc.gov/ecfs/document/view?id=7520939733>

F. Mandate setbacks from cell tower installations: 1500' minimum at 150' in height.
Discourage DAS systems.

G. Create a comprehensive map of all RF transmitters throughout the US that is publicly available, and on the internet.

H. Establish RF safe zones in every state, for example, on federal wilderness lands, where RF transmitting infrastructure, except for emergency use, is prohibited.

I. Ensure more local control over RF transmitters and local ability to establish wireless free zones.

J. Enforce compliance with FCC rules on the Grants of Equipment Authorization.

K. End time averaging rules for pulsed radiation, and require industry to provide peak pulse figures for wireless transmitters.

L. Prohibit RF installations that exceed thermal RF exposure guidelines.

M. Protect cell tower workers by mandating transmitters be turned off when workers are present.

Respectfully submitted by:

/s/ _____

Sandi Maurer

EMF Safety Network

PO Box 1016

Sebastopol CA 95473

October 30, 2013

AFFIDAVIT OF SANDI MAURER

State of California,
Sonoma County

I, Sandi Maurer, attest that the statements above and in my Comments are true to the best of my knowledge.

1. My name is Sandi Maurer. My business address is:

EMF Safety Network
PO Box 1016,
Sebastopol, CA 95473

2. I am a founding member and director of the EMF Safety Network (Network), which began in October 2009 with the launch of our [website](#). Network evolved out of a successful, 2007 campaign that opposed installation of city wide wireless internet in Sebastopol California. Network is a coalition of business and property owners, and utility customers. We provide public education on health, environmental, and safety impacts associated with electromagnetic fields (EMF) and radiofrequency radiation (RF, radiation or wireless), and offer resources for support of public policy change.

3. I have participated in three California Public Utilities Commission (CPUC) proceedings. In April of 2010, I filed the Application of EMF Safety Network for Modification of D.06-07-027 and D.09-03-026 (A. 10-04-018). Processing the application included filing of six more documents: a response; two ex-parte notices; comments on the proposed decision; reply comments; and a rehearing request.

In A.11-03-014, the PG&E Smart Meter opt-out proceeding: I have filed more than ten pleadings on behalf of Network. I also issued discovery requests to PG&E, SDG&E and SCE. In Investigation 12-04-010, I have participated fully on behalf of Network.

ATTACHMENT A: SMART METER DECLARATIONS**Declaration of Allison Elaine Panelli**

I, Allison Elaine Panelli, have personal knowledge of all facts set forth in this declaration and am competent to testify thereto if called upon to testify in a court of law. I hereby declare:

1. My name is Allison Elaine Panelli, and I reside at ...
2. I am a utility customer of Glendale Water and Power (GWP).
3. Since a first generation smart meter was secretly installed on my home years ago, with no warning or notification whatsoever, I am now electrosensitive and have removed all other wireless devices from my home.
4. On 5/24/11, I received a letter concerning smart meters from GWP stating that "While GWP is not regulated by the CPUC, we feel that it is appropriate to follow its guidelines with issues such as this." Their opt out program has now emerged, and they ARE NOT following the CPUC guidelines. I believe their letter was a lie to pacify those of us who are not in agreement with smart meters. Their opt out is a complete sham. They're not allowing anyone to retain their analog meters, and they are charging the outrageous fee of \$56, per billing cycle, for an electric smart meter with a radio turned off.
5. I am experiencing the following symptoms due to the radiation emitted from smart meters: headaches, tinnitus, insomnia, dizziness, nausea, vomiting, depression, and lethargy. My facial skin has also become extremely dry and rough, as if it has been burned.
6. My daughter experiences the following symptoms due to smart meter radiation: chronic bloody noses and occasional headaches.
7. I believe that every customer deserves to have an analog opt out. A smart meter with a radio turned off will still fill a home with dirty electricity and cause multiple symptoms for those with electrosensitivity, such as myself.
8. Charging opt out fees is extortion, is likely illegal, and should not be tolerated.

I declare under penalty of perjury under the laws of the State of California that the facts set forth above are true and correct to the best of my knowledge. This declaration was executed this 10th day of May, 2012 at Glendale, California.

/s/ _____

Allison Elaine Panelli

Declaration of Abram S. Perlstein

I, Abram S. Perlstein, have personal knowledge of all facts set forth in this declaration and am competent to testify thereto if called upon to testify in a court of law. I hereby declare:

1. My name is Abram S. Perlstein, and I reside at ...
2. I am a renter in a shared home. My landlord / housemate is a utility customer of Pacific Gas & Electric Company (PG&E).
3. I have been sharing this home with my landlord/housemate since July, 2000. We still have an analog PG&E electric meter installed on this home. However, the two homes to either side of our house have recently installed wireless electric smart meters. The meter on the house to the north was installed a little over a year ago. The meter on the house to the south was installed a few months ago.
4. Since the installation approximately 35-feet from my bedroom on the house directly to the north, I have been experiencing very loud and extremely high pitched ringing in my ears a lot of the time. I've never experienced ringing in the ears before.
5. Since the installation of the smart meter---located approximately 30-feet away from my bedroom and 10 or 15 feet from my dining area and kitchen---on the north wall of the house directly to the south of my house, ringing in the ears has become unbearable.
6. Additionally, since the meter on the house to the south was installed a few months ago, I never seem to get deep REM sleep any more. While I do have a medically diagnosed mild sleep apnea condition (as proven from two overnight sleep studies), even with sleep apnea, I slept so much sounder than before the meter on the house to the south had been installed. I would wake up feeling at least somewhat refreshed. I am now chronically sleep deprived, lucky to get four, and sometimes five to six hours of uninterrupted sleep per night. I feel simply horrible upon awakening each morning. My mind is muddled, versus being refreshed. Drinking caffeinated teas, coffees, or other energy-type drinks do not help as caffeine withdrawal does not work well with my system.
7. Additionally, when I am in the house, my blood pressure is routinely higher than normal. This has been proven by monitoring my blood pressure through regular readings detected with an electronic digital cuff device.
8. Since the first meter to the north went in, and more so now since the second meter went in, I experience mild to substantial cognitive impairment virtually all the time. I never had this condition before.

9. When I leave this house and the surrounding radio frequency pollution, the ringing in my ears goes away almost instantly. My blood pressure goes back to normal (I've tested it numerous times with a portable blood pressure monitor. Doing so has repeatedly confirmed this fact.). And my thinking process returns to a clearer state of mind.

I declare under penalty of perjury under the laws of the State of California that the facts set forth above are true and correct to the best of my knowledge. This declaration was executed this 27th day of May, 2012 at Los Osos, California.

/s/_____
Abram S. Perlstein

Declaration of Beverly Filip

I, Beverly Filip, have personal knowledge of all facts set forth in this declaration and am competent to testify thereto if called upon to testify in a court of law. I hereby declare:

1. My name is Beverly Filip, and I reside at ...
2. I am a utility customer of Pacific Gas and Electric (PG&E).
3. I am sensitive to EMF and have removed all wireless devices , including cordless telephones, from my home to protect my health.
4. I do not have a Smart Meter on my home, but I am surrounded by Smart Meters on my neighbors' homes.
5. Since Smart Meters were installed in my neighborhood I have experienced worsened tinnitus and worsened insomnia.
6. I think it is very unfair and wrong to charge me more money not to have a Smart Meter on my home.

I declare under penalty of perjury under the laws of the State of California that the facts set forth above are true and correct to the best of my knowledge. This declaration was executed this 21st day of June, 2012 at Eureka, CA.

/s/ _____
Beverly Filip

Declaration of Carole Jones

I, Carole Jones, have personal knowledge of all the facts set forth in this declaration and am competent to testify thereto if called upon to testify in a court of law. I hereby declare:

1. My name is Carole Jones, and until March 2012, I resided at ...(Sonoma, California)
2. Until March 2012, I was living with my sister Jeanine Masonek and her husband Bruce Masonek, who were utility customers of Pacific Gas and Electric.
3. I was unaware that a Smart Meter had been installed on our house, but I suddenly began having severe, debilitating headaches, joint and muscle pain, muscle cramping, elevated blood pressure, irregular heartbeat, insomnia, and an intermittent buzzing/tingling sensation in my legs and feet that happened every few seconds day and night, and I realized on checking with the electric company, that my symptoms began right after the Smart Meter was first installed. What further confirmed for me my suspicion that my symptoms were connected to the Smart Meter was the fact that my symptoms completely disappeared when I would go to stay a few days at my daughter's house in Marin County (which has placed a moratorium on Smart Meter installation, so consequently none of the houses or businesses in her area have Smart Meters).
4. The effects of the Smart Meter were so debilitating for me that I have relocated to North Carolina, to an area where there are no Smart Meters.

I declare under penalty of perjury that the foregoing is true and correct. I have personal knowledge of all the facts set forth in this declaration and am competent to testify thereto if called upon to testify in a court of law. This declaration was executed this 3rd day of April, 2012 at Asheville, North Carolina.

/s/ _____
Carole Jones

Declaration of Cynthia Sue Larson

I, Cynthia Sue Larson, have personal knowledge of all facts set forth in this declaration and am competent to testify thereto if called upon to testify in a court of law.

I hereby declare:

1. My name is Cynthia Sue Larson, and I reside at ...
2. I am a utility customer of Pacific Gas & Electric (PG&E).
3. Without my knowledge or consent, “smart” meters were installed on my home.
4. On the evening of Friday, November 18, 2011, I returned from having been out of town to a smart-meter free location for ten days, and immediately noticed an incessant ringing in my ears that had been absent during my trip. By Sunday, November 20th, I noted a return of chronic upper respiratory hemorrhaging that began a few months prior to my trip, had gotten progressively worse before my trip, that cleared up completely during my trip, and that now returned with a vengeance along with difficulty sleeping, blurred vision, difficulty concentrating, and headaches.
5. By January 16, 2012 I contacted PG&E by phone and letter regarding my need to have smart meters removed from my home, but never received a clear answer as to when analog meters could be reinstalled--that is, until the day of the CPUC ruling on February 1, 2012. My analog meter operated beautifully for decades, without causing me any problems. I logged my smart meters complaints at the SmartMeterHelp.Com website on January 16, 2012.
6. The week of January 21st, 2012, while sick with strep throat, I became keenly aware of numerous debilitating symptoms far beyond strep throat, so even when I made a full and complete recovery from strep throat, I was far from well. My symptoms included: chronic upper respiratory hemorrhaging, constant ringing in my ears, headaches, nausea, blurred vision, heart palpitations, and body-wide random muscle spasms whenever I was in my home.

7. On February 8th, 2012, Rodney, a PG&E representative, replaced the smart meters with analog meters. While I still hear some ringing in my ears (apparently from neighbors' smart meters), my headaches, blurred vision, nausea, heart palpitations, muscle spasms and upper respiratory hemorrhaging stopped and have not returned.

I declare under penalty of perjury that the foregoing is true and correct. I have personal knowledge of all facts set forth in this declaration and am competent to testify thereto if called upon to testify in a court of law. This declaration was executed this 5th day of April, 2012, at Berkeley, California.

/s/ _____
Cynthia Sue Larson

Declaration of Elizabeth Barris

I, Elizabeth Barris , have personal knowledge of all facts set forth in this declaration and am competent to testify thereto if called upon to testify in a court of law. I hereby declare:

8. My name is Elizabeth Barris and I live at ...
9. I am a customer of Southern CA, Edison – Electric.
10. On June 1st, I moved into an apartment that had an RF (radio frequency) meter on it.
11. When I told my land lord that the meter was giving me severe health effects such as sharp pains in my ears and head, severe and debilitating head aches, high blood pressure and ringing in my ear, and frightening heart arrhythmia, my land lady and I then called Edison together on a conference call, to have the meter removed. We spoke with senior customer service rep., Kari Gardner at Edison, who informed us it would cost us approximately \$4,000 extra per year in bills to have the RF meter replaced with an analog meter. My land lady then informed me that I would have to pay these extra costs, despite the fact that the meter was shared by other tenants and that it was physically debilitating to me. This is a violation of the ADA.
12. When I attended a public CPUC meeting and told President of the CPUC, Michael Peevey about the meter's health effects on me and extra charges we were told we would have to pay in order to have the meter removed, he then told me that the public meeting was not the time or place to discuss the charges, even though that was the reason I was unable to have the meter replaced. In other words, my complaints about the \$4,000 extra charges to have the RF meter switched to a safe analog meter were ignored by the president of the CPUC, Michael Peevey.
13. And finally, In an attempt at intimidation, Edison rep., Kari Gardner, actually filed a false claim against me to Senior Services of LA County, saying I was a physical threat to my land lord due to the RF meter on the house which I had unsuccessfully attempted to have removed. A claim which when verified by Senior Services, both myself and my land lord, Loretta Sosa of 1124 Rosario Drive Topanga, CA 90404 denied. Bullying tactics like this should never be tolerated by a private corporation, let alone a public utility. This same rep also told me she would call law enforcement, have me arrested and file charges against me were I to replace the RF meter on the house with an analog meter.
14. Because of the health effects RF meter on the apartment has caused me, I am now having to move to an apartment where the owner has promised they will never

allow for a smart meter to be placed on the apartment or even property. This move has cost me money, stress and the RF meter that I lived with for 9 months has caused me possibly permanent damage from the pulsed radiation my ear, head, heart and other body parts absorbed during the time that I was in the apartment with the RF meter.

I declare under penalty of perjury under the laws of the State of California that the facts set forth above are true and correct to the best of my knowledge. This declaration was executed this 26th day of February, 2012 at Topanga, CA.

/s/ _____
Elizabeth Barris

Declaration of Ellen Kay Cecil

I, Ellen Kay Cecil, have personal knowledge of all facts set forth in this declaration and am competent to testify thereto if called upon to testify in a court of law. I hereby declare:

1. My name is Ellen Kay Cecil, and I reside at ...
2. I am a utility customer of Pacific Gas & Electric Company AKA PG&E.
3. After 10-15 minutes of exposure to one “Smart Meter” from a distance of 6 feet, I began to experience heart palpitations and felt physical distress so that I had to quickly move away as I feared for my health, the condition of my heart and my very life.
4. My neighborhood is saturated with multiple “Smart Meters” which lead me to believe that PG&E has been grossly negligent, greedily profit-driven as well as totally cold-blooded regarding the health, safety, privacy, finances and well-being of both the trusting public and the fine communities (such as mine) into which they have been deploying their “Smart Meters.”
5. My viewpoint is that the reprehensible “love of money” is driving this giant utilities monopoly to charge for a “non-service,” i.e., the “Smart Meter ‘Opt-Out’” fee and additional monthly charges; therefore, it is my opinion that all fees should be refunded to the ratepayers.
6. Since there has been a hasty roll-out of “Smart Meters” despite the preponderance of evidence pointing to “Smart Meter” related fires, increased rates, health issues and more, it is my strong conviction that PG&E should be forced to remove all “Smart Meters” immediately from all service areas.

I declare under penalty of perjury under the laws of the State of California that the facts set forth above are true and correct to the best of my knowledge. This declaration was executed this Nineteenth day of June, 2012, at Marina, California.

/s/ _____
Ellen Kay Cecil

Declaration of Ellen Marks

I, Ellen Marks, have personal knowledge of all facts set forth in this declaration and am competent to testify thereto if called upon to testify in a court of law.

I hereby declare:

1. My name is Ellen Marks and I reside at ...
2. I am a utility customer of Pacific Gas and Electric Company (PG&E).
3. My husband Alan Marks has brain cancer attributed to the radiation from his cell phone. Shortly after installation of the smart meters on our home I was diagnosed with hypothyroidism. I never had the symptoms prior to the installation of the smart meters- fatigue, depression, joint pain, heart racing, and weight gain. I also suffer from atypical trigeminal neuralgia- a very painful nerve disease in the face that causes electrical jolts within my face and head. It worsened with the smart meters.
4. Denise Alexander of PG&E did have my meters removed when I notified her of my husband's illness. I never mentioned my problems as his alone are reason enough to not be subjected involuntarily to the very thing that is killing him. Shortly after the removal of the meters I received a hand signed letter from Mr. Devereaux that the meters will be going back on. I just received a recorded call from PG&E stated they will be here to put them back on within 30 days. I cannot and will not allow this to happen.
5. My smart meters have been permanently removed but I take great offense for having to pay not to have them. My husband's illness has greatly affected our finances and we should not be punished by PG&E and the CPUC in this manner.

I declare under penalty of perjury under the laws of the State of California that the facts set forth above are true and correct to the best of my knowledge. This declaration was executed this 25th day of May, 2012 at Lafayette, California.

/s/ _____
Ellen Marks

Declaration of Judith Ann Brenner

I, Judith Ann Brenner, have personal knowledge of all facts set forth in this declaration and am competent to testify thereto if called upon to testify in a court of law.

I hereby declare:

1. My name is Judith Ann Brenner, and I reside ...
2. I am a utility customer of Southern California Edison (SCE).
3. I have a pacemaker and am sensitive to EMF and need to protect my health. There are Smart Meters and wireless devices surrounding my home at my neighbors homes. The electric stanchion is right outside my Master bedroom and bath where I spend, at least, ten hours a day.
4. I have been required by SCE to provide them with a decision to opt out of Smart Meter installation and pay an initial \$75 and \$10 per month by July 9, 2012 even if there is a health issue involved.
5. SCE told me there are no exceptions to the decision and CPUC advised me there was nothing they could do. The Commissioners are not accessible. Purportedly, there is a Phase 2 of the opt-out discussions but there is no way for me to express my concerns.
6. I think it is an unfair penalty for any individual with a medical concern to pay to not have a Smart Meter in my home.

I declare under penalty of perjury under the laws of the State of California that the facts set forth above are true and correct to the best of my knowledge. This declaration was executed this 27th. day of June, 2012 at Ventura, CA.

/s/ _____
Judith Ann Brenner

Declaration of Joan Farber

I, Joan Farber, have personal knowledge of all the facts set forth in this declaration and am competent to testify thereto if called upon to testify in a court of law. I hereby declare:

1. I, Joan Farber, reside at ...
2. I am a utility customer of Southern California Edison.
3. A Smart Meter was installed at my residence and the apartment complex across the street from my house, and throughout the neighborhood.
4. Since these installations I have discovered that I am sensitive to EMF.
5. I have been experiencing serious health problems which did not exist prior to the installation of these Smart Meters: Severe intestinal disturbances, increased anxiety, forgetfulness, loss of appetite, depression and poor concentration. I had fibromyalgia prior to the Smart Meters, but a new regime of medication and accupuncture had relieved the symptoms dramatically. The pain has increased.
6. I think it is unfair and wrong to charge money not to have a Smart Meter on my home.

I declare under penalty of perjury under the laws of the state of California that the facts set forth above are true and correct to the best of my knowledge. This declaration was executed this 17th of June, 2012 at Ojai, California.

/s/ _____
Joan Farber

Declaration of Juliene G. Lipson

I, Juliene G. Lipson, have personal knowledge of all facts set forth in this declaration and am competent to testify thereto if called upon to testify in a court of law. I hereby declare:

1. My name is Juliene Lipson and I reside at ...
2. I am a utility customer of Pacific Gas and Electric (PG&E).
3. I am sensitive to EMF and have removed all wireless devices from my home to protect my health.
4. I have solar panels and do not have a Smart Meter on my home, but I am surrounded by Smart Meters on my neighbors' homes in a neighborhood in which homes are very close together.
5. Since Smart Meters were installed in my neighborhood, my formerly very mild electrical sensitivity worsened significantly and rapidly. I experience insomnia, frequent headaches, worsened sinus disease, tinnitus, and such cognitive problems as poor short term memory, confusion, and disorganization.
6. Quality of life: Since neighborhood SmartMeter installation I can no longer tolerate my hybrid car, air travel, or spend more than ½ hour in downtown areas with multiple cell towers and wi fi in every building. Deterioration of my sense of direction has led to getting lost or inability to find my car, and vision changes discourage me from driving at night.
7. I am angry that SmartMeter installation has ruined my health and consider it wrong and unfair to charge me to avoid Smart Meters on my home.
8. I declare under penalty of perjury under the laws of the State of California that the facts set forth above are true and correct to the best of my knowledge. This declaration was executed this 26th day of May, 2012 in Novato, CA.

/s/ _____
Juliene G. Lipson, RN, PhD
Professor emerita, UCSF

Declaration of Julie Ostoich

I, Julie Ostoich, have personal knowledge of all facts set forth in this declaration and am competent to testify thereto if called upon to testify in a court of law. I hereby declare:

My name is Julie Ostoich and I reside at...

1. I am a utility customer of Pacific Gas and Electric (PG&E) and Sacramento Municipal Utility District (SMUD).
2. I am writing to you regarding perceived and real health issues related to the SmartMeter that PG&E installed on my home. I do not want any SmartMeter devices installed on my home or property. I have refused to allow the Sacramento Municipal Utility District (SMUD) access to install yet another meter on the back of my house directly outside the bedrooms.
3. The PG&E SmartMeter was installed in the front of my house on the wall directly outside my living room. I did not grant permission for the installation of the SmartMeter device nor was I asked for consent. Recently, I received information regarding their "opt-out" program and intend to contact them to take avail of it.
4. Since the installation of SmartMeters in our neighborhood, I have suffered with tinnitus, muscle cramps, sleep disturbance, chronic fatigue, heart palpitations, migraines, blurred vision, and dizziness. I am lucky if I get 4 hours of disrupted sleep a night. When I visit my father in Shasta County who lives in an area where there are no SmartMeters as yet, the tinnitus stops completely. I sleep well and feel much better. I informed my doctor about this at a recent appointment in March, 2012.
5. I am aware of health concern risks related to the wireless transmissions that the SmartMeters use. Scientific evidence indicates potential harm from sporadic and cumulative exposure. Sensitivity among people varies and many may fail to make the connection of symptoms to these devices. Furthermore, the stated output of these devices has been grossly misleading and false. I do not want these devices on my home or in my neighborhood. I do not want to risk the health of my family from SmartMeter pollution.
6. I informed SMUD of my disapproval and explained my reasons for refusal of installation of a SmartMeter. At a recent board meeting, SMUD discussed their 'opt-out' program. At this meeting, they discussed intentionally informing only their customers who have so far refused installation of the SmartMeter and not disseminating the information to all customers. They also made improper comments about those who like me feel that there are verifiable health risks involved with this technology. SMUD's *munificent* opt-out is to make it grossly

unaffordable to their customers. The fees they discussed for opting out and monthly charges thereafter far exceed what PG& E is offering. One board member actually said that if SMUD customers didn't like it or couldn't afford it, they could move to PG&E territory.

7. It is perplexing that during this recession and lack of jobs, that this type of program is being allowed. How many jobs are being replaced by these units? I am appalled that the complaints and health risks posed by these devices are not being taken seriously. I want to stop this insane and ill-conceived technology from being promoted and deployed further.

I declare under penalty of perjury that the foregoing is true and correct. I have personal knowledge of all facts set forth in this declaration and am competent to testify thereto if called upon to testify in a court of law.

This declaration was executed this 4th day of April, 2012 at Sacramento, California.

/s/ _____
Julie Ostoich

Declaration of Kai Gonzalez

I, Kai Gonzalez, have personal knowledge of all facts set forth in this declaration and am competent to testify thereto if called upon to testify in a court of law. I hereby declare:

1. My name is Kai Gonzalez, and I reside at
2. I am a utility customer of Southern California Edison (SCE).
3. A Smart Meter Delay List was not available to SCE utility customers until days AFTER the installation of the SmartConnect smart meter on the side of my home in September 2011. I should have been allowed to join that Delay List, and I was not.
4. A bank of radiating smart meters (in my case, 10 smart meters on the side of my home) clearly poses a greater health risk than a single smart meter. It should be mandated that banks of smart meters be returned to analog when meters are attached to a dwelling, at NO COST to the affected family. The affected family should have the right of veto if smart meter installation is being proposed.
5. The 10 smart meters on our home face the public sidewalk, where children play, and Radiofrequency Warning Signage should be displayed, which is required by the FCC, but is not enforced by the FCC: <http://transition.fcc.gov/oet/rfsafety/rf-faqs.html#Q21>
6. My family's health has been affected: Since the day the smart meters were installed in September 2011, my husband, our young toddler, and myself have all suffered from interrupted sleep every single night. Our toddler took to banging his head on his crib each night after the installation. When we left our home to visit relatives, we had no sleep issues. I have read that interrupted sleep is a classic symptom of harmful exposure to smart meters. As well, I was diagnosed with Acute Labyrinthitis in January 2012. I was not sick at the time and had never been dizzy like that in my life. The dizziness has continued to this day. I have read that dizziness is a side effect of radiation exposure.
7. Baby monitor affected: Since the installation, our baby monitor emits loud, crackling static to the point where we often cannot use it, and this is a safety issue for us.
8. SCE came to my home to test the smart meters in November 2011 and the Rep admitted the reading was surprisingly high at one point, using the Gauss meter. She recommended that I should move from my home if I didn't feel safe.
9. The SCE Smart Meter Opt-Out Plan of April 2012 is only for single-metered homes, and provides no option for banks of meters where one single family is

affected by 24/7 pulsing radiation from all neighbors' meters. As well, the high opt-out fees are not affordable: \$75 setup plus \$10/month = \$195 for the first year. In my case, I would have to absorb the opt-out cost (\$1,950) for all ten smart meters in order to protect my family from radiation. These high fees are a form of discrimination. I already pay my electric company every month—for service, not for extra radiation.

10. Until the 10 smart meters are changed back to analog, I am requesting that SCE install Faraday Cages to protect my family from the RF exposure that we are being subjected to.
11. I have read that alternatives to the smart meters exist—they should be implemented, in the name of public safety. Corporate profit should not usurp public safety.

I declare under penalty of perjury under the laws of the State of CA that the facts set forth above are true and correct to the best of my knowledge. This declaration was executed this 15th day of May, 2012, at Tustin, CA.

/s/_____
Kai Gonzalez

Declaration of Keith James Kocsis

I, Keith James Kocsis, have personal knowledge of all facts set forth in this declaration and am competent to testify thereto if called upon to testify in a court of law. I hereby declare:

1. My name is Keith James Kocsis and I reside at ...
2. I am a utility customer of PG&E.
3. Since the installation of my neighbors' smart meters in mid-2011 (my wife and I opted out of the smart meter program, but we are still affected by the smart meters in our neighborhood) I have suffered from daily heart palpitations, dizziness, headaches, worsened tinnitus, insomnia, and fatigue. I am a very healthy person otherwise, and I take excellent care of myself and my health.
4. Since the installation of my neighbors' smart meters in mid-2011 three of my previously healthy pets died suddenly. Two cats died of heart failure within two days of each other, and my lovebird died from a sudden onset of daily seizures.

I declare under penalty of perjury that the foregoing is true and correct. I have personal knowledge of all facts set forth in this declaration and am competent to testify thereto if called upon to testify in a court of law.

This declaration was executed this 10th day of April 2010 at San Francisco California

/s/ _____
Keith James Kocsis

Declaration of Linda Marie Stedjee

I, Linda Marie Stedjee, have personal knowledge of all facts set forth in this declaration and am competent to testify thereto if called upon to testify in a court of law. I hereby declare:

1. My name is Linda Marie Stedjee, and I reside at ...
2. I am a utility customer of Pacific Gas and Electric (PG&E).
3. I have significant health problems and believe that smart meters are a serious threat to my health and well being.
4. I do not have a Smart Meter on my home, but I am surrounded by Smart Meters on my neighbors homes.
5. Since Smart Meters were installed in my neighborhood I have experienced constant tinnitus, something I did not have before the meters were installed. I have also experienced otherwise-unexplained sleep disturbances.
6. Even though I was on PG&E's list for delayed installation, an installer came to my house fairly early in the installation process in my town. I ordered him to leave my property, and he did so, but the fact remains that PG&E violated its promise to ensure delayed installation for those who requested it.
7. I consider it outright extortion to charge me money not to have a Smart Meter on my home. This reminds me of the protection rackets run by gangsters who tell their victims, "pay up or we will hurt you."

I declare under penalty of perjury under the laws of the State of California that the facts set forth above are true and correct to the best of my knowledge. This declaration was executed this 11th day of May, 2012 at Morro Bay, CA.

/s/ _____
Linda Marie Stedjee

DECLARATION

I, LOUISE KIEHL STANPHILL, have personal knowledge of all facts set forth in this Declaration and am competent to testify thereto if called upon to testify in a court of law. I hereby declare:

1. My name is Louise Kiehl Stanphill, and I reside at ...
2. I am a utility customer of PG&E.
3. In October, 2009, I suffered a severe electrical shock to my head while using a cell phone plugged into an electrical wall socket in my home. Since then, I've suffered from chronic nerve pain, headache, heart palpitations, insomnia and other symptoms when in proximity to wireless devices, including wireless Smart Meters, fluorescent lighting, and many electrical appliances.
4. In January, 2010, I contacted PG&E through its website requesting an opt-out from the Smart Meter program due to health reasons. My request was rejected.
5. On or about March 20, 2010, I filed Complaint No. 28145 with PG&E and was put on the "Last to Install List" due to health reasons.
6. In and around August 31, 2010, PG&E's subcontractor Wellington Energy installed electric and gas Smart Meters throughout my neighborhood in Santa Rosa. I refused installation.
7. Since deployment of Smart Meters in my neighborhood in late August, 2010, my symptoms of electrosensitivity have worsened, and I have lost the use of portions of my home and property because I must avoid proximity to neighborhood wireless Smart Meters.

I declare under penalty of perjury that the foregoing is true and correct. I have personal knowledge of all facts set forth in this Declaration and am competent to testify thereto if called upon to testify in a court of law.

This Declaration was executed this 7th day of April, 2012, at Santa Rosa, California.

/s/ _____
Louise Kieh Stanphill, Declarant

Declaration of Linda Sue Kocsis

I, Linda Sue Kocsis, have personal knowledge of all facts set forth in this declaration and am competent to testify thereto if called upon to testify in a court of law. I hereby declare:

1. My name is Linda Sue Kocsis and I reside at ...
2. I am a utility customer of PG&E.
3. Since the installation of my neighbors' smart meters in mid-2011 (my husband and I opted out of the smart meter program, but we are still affected by the smart meters in our neighborhood) I have suffered from daily heart palpitations, dizziness, headaches, tinnitus, shortness of breath, insomnia, and fatigue. I am a very healthy person otherwise, and I take excellent care of myself and my health.
4. Since the installation of my neighbors' smart meters in mid-2011 three of my previously healthy pets died suddenly. Two cats died of heart failure within two days of each other, and my lovebird died from a sudden onset of daily seizures.

I declare under penalty of perjury that the foregoing is true and correct. I have personal knowledge of all facts set forth in this declaration and am competent to testify thereto if called upon to testify in a court of law.

This declaration was executed this 10th day of April 2010 at San Francisco California

/s/ _____
Linda Sue Kocsis

Declaration of Lisa S. Moskow

I, Lisa S. Moskow have personal knowledge of all facts set forth in this declaration and am competent to testify thereto if called upon to testify in a court of law. I hereby declare:

1. My name is Lisa S, Moskow, and I reside at ...
2. I am a utility customer of PG&E.
3. A “Smart” meter was installed without my permission.
4. The “Smart” meter caused damage to the electricity in my house: Many electric outlets stopped working and I wasn’t able to heat my house adequately because appliances which use a lot of electricity would trip the circuit breaker. I put everything on circuit breaker strips as a safety measure, but the toaster oven wore out the circuit breaker strip that was brand new—it was literally “fried”.
5. I alerted PG&E that the problem seemed serious and they said they would replace my “smart” meter. They did put another meter there that LOOKED like an analog meter, but when the electrician came he pulled a label off of it, and underneath the label was written: Smart Meter. Before this change, fire actually came out of one of the plugs in my house. The damaged outlets were still damaged with the new meter, but I could use the toaster oven and one small electric heater—not enough for the winter with me having arthritis. I used mostly wood heat this last winter. I decided to wait until I got a truly analog meter before getting my electricity worked on. I am a low-income senior and this is a big expense for me. Also it doesn’t seem fair that I should pay for damage caused by PG&E. I opted out for the truly analog meter and got that done April 3rd--not without a big hassle.
6. I began realizing that I was being negatively affected health-wise by both “smart” meters. So I moved my computer out of the room that has the “smart” meter close to it and have done all my computer work in the living room which is farther away from the “smart” meter. After several months of working in the living room, my serious insomnia and mental confusion/disorganization have improved very much. I was taking 3 naps a day and propping myself up with coffee (was not previously a coffee drinker) in order to do daytime activities safely (like driving). I was doing anything requiring a clear mind at night where I “magically” became alert.
7. I went to many CPUC meetings to protest these meters and met some people who are very seriously electromagnetically sensitive. I am not that electrosensitive, but I see now from experience that the negative health effects are cumulative and that these negative effects are present in varying degrees in everyone.
8. I do not feel that PG&E has the right to impair ANY of my mental and physical

functioning—and then to require me to pay them to stop impairing my life energy.

9. I have fennel bushes next to the “smart” meter that attract many birds and bees—I have watched these year after year out the window where I work on the computer. Now there are no birds or bees coming to those bushes and not one even since the analog meter was returned. Uncontrolled EMF radiation is harmful to all life.

I declare under penalty of perjury under the laws of the State of California that the facts set forth above are true and correct to the best of my knowledge. This declaration was executed on May 6, 2012 in San Rafael California.

/s/ _____
Lisa S. Moskow

Declaration of Mary Hankins

I, Mary Hankins, have personal knowledge of all facts set forth in this declaration and am competent to testify thereto if called upon to testify in a court of law. I hereby declare:

1. My name is Mary Hankins, and I reside at ...(Ann Arbor, MI)
2. I am a previous utility customer of Pacific Gas and Electric (PG&E)
3. We had been living healthfully in Silicon Valley for 5 years before the Smart Meters came and changed everything. We had purchased an expensive house in an upscale neighborhood (Willow Glen in San Jose) thinking we would be there for the long haul and had established professions and personal relationships. We both worked at home at times, I more often as I moved from full time technology marketing (Director) to consulting work. We were both very healthy, running 5 – 7 miles a day, hiking often, and eating organically.
4. In early 2010, I began to have a number of health issues/symptoms and strange sensations: constant and loud ringing in my ears, bad insomnia wherein I awoke frequently shaking or trembling, tingling up the back of my neck and into my head, abdominal pain, moodiness, and fatigue. Thinking it was overwork, I cut back on my hours. However, my symptoms did not abate, they worsened. I began to have heart palpitations and pounding, intense eye pain, vision changes, flashing lights that seemed to be literally behind my eyes, and “shock like” sensations which jolted my body. My chest felt tight and heavy. Often I would be discussing something and would completely forget what I was talking about. More and more, the conversations my husband and I had in the kitchen included the phrase “The the...what’s that word again?” I woke up frequently with the sensation that my head was in a vice (pressure on my head) and had an acute onset of chemical allergies which, like my other symptoms, was most prevalent inside our house. Confused, I tried to determine what could be happening. My symptoms increased and I began to feel sicker in our house – nosebleeds, sore throat, weakness and hives were added to the list. I went to my primary doctor. Routine blood work collected on 3/16/2010 showed that my liver tests were abnormal (elevated) and that my blood had toxicity in it. (Attached). I had never had abnormal liver tests in my life.
5. As I began to discover that my symptoms were worst while inside the house and lessened when we were away down the coast visiting friends or up north in San Francisco, I analyzed what had changed and where I spent a lot of time. The trembling, hives, intense acute head pain, and flashing lights had all happened in the kitchen where I often worked or spent time cooking. The other symptoms were constant while in the house in general. I spoke with friends down the street who were also not feeling well. She had had a relapse of her MS, he was

experiencing intense migraines, their dog was sick and one of their ducks had stopped laying eggs completely. Thinking this was strange, I looked online.

6. I remembered that the electric (and gas) meters had been replaced and after doing some research online, I discovered that my symptoms were in line with many others suffering the effects of acute electromagnetic exposure following a smart meter installation. I learned that PG&E had been deploying the Grid in our area and that these were actually cellular devices communicating with all the other meters in our neighborhood and collection meters (the mesh system) which was never communicated to us by PG&E before install. Distraught, on 3/29/2010, I called PG&E to discuss the meter and my symptoms. I was told that the meters were no stronger than a microwave oven and that I was safe “at 6 feet” and that they were not removing them. Often, I had been closer than 6 feet to this meter given where our kitchen sink, island counter, phone, and kitchen table were.
7. I could not believe that the utility company would install something that was not safe; however, I tried to go on with my life and spend more time working on my health.
8. I began working with a Naturopath – Dr. Suzanne Wang, ND, in Palo Alto to help with the EMF and chemical sensitivities. We made many changes to the interior of our house to reduce toxins including discarding furniture, throwing away our mattress and purchasing an all-natural mattress, and replacing carpeting with no VOC hardwood. I worked aggressively to help detox my body. However, none of this did anything to relieve my symptoms. My health continued to deteriorate and I began feeling extremely agitated most of the time and couldn't concentrate well, often completely forgetting what I was talking about. I often lost balance, began to have chronic muscle spasms and muscle weakness and was weak and shaky often. I remember standing in the kitchen one day on the phone and starting to tremble. At one point, I had to rush to the counter as I realized I was about to drop a cup of coffee. I suddenly felt 80 when I was only 46.
9. Feeling awful, we moved into a hotel for 3 weeks in Los Gatos. I felt much better and was able to do some part time work for one of my clients. (I had had to leave my Director/consultant role in June as I was unable to spend much time online now).
10. Again, on 11/3, I again called PG&E. I had heard you could have these removed. The representative (Liz) told me someone that I could speak to the Smart Meter group (hotline) about having it removed and someone would call to discuss my options. On 11/24, at 3:33 PM, the Smart Meter Department of PG&E called. The representative told me that PG&E “could not remove the meters, they were safe per the FCC, just stay 10 feet away from it”.
11. I tried to stay out of the house as much as possible. We spent several weeks away

in December and in January, we rented a colleague's house in Mountain View where the smart meter was much further away from the kitchen and bedroom. Finally, still unable to be in our house, on Feb 14th, 2011, we moved into a rental house in Santa Cruz where Smart Meters had not been deployed. There I was able to improve my health, if only for a few months as evidenced my improved blood tests. (Attached) Unable to get the meter removed on our house in San Jose and now feeling awful when in any area with smart meters deployed. (My husband and I have since gathered many readings and see the meters spike several times within a minute at high levels. I also know a lot about the mesh network now and realize that all these meters are constantly pulsing and communicating, keeping the connection alive and managing the network creating a very unhealthy environment and uncomfortable environment for people),

12. We have since abandoned our house and California all together and relocated to Ann Arbor, Michigan where, sadly, the meters are now on their way. We are preparing to run again once they get to our neighborhood.
13. These meters took years of my life away, created havoc and constant emotional turmoil for myself and my husband, disrupted a successful career and have permanently damaged my health. I now have chronic EHS (MD documentation attached) and we were forced to abandon our plans to adopt a child, one of the biggest disappointments of my life. How could PG&E and the government(s) do such a thing to so many people?

I declare under penalty of perjury under the laws of the State of California that the facts set forth above are true and correct to the best of my knowledge. This declaration was executed this 12th day of May, 2012 at Ann Arbor, Michigan.

/s/ _____
Mary Hankins

Declaration of Marla June Crites

I, Marla June Crites, have personal knowledge of all facts set forth in this declaration and am competent to testify thereto if called upon to testify in a court of law. I hereby declare:

1. My name is Marla June Crites, and I reside at ...
2. I am a utility customer of Pacific Gas and Electric (PG&E).
3. A Smart Meter was installed on my home over my objections in August 2010.
4. At first I did not notice any ill effects, but over time symptoms began to accrue.
5. By November 2011 I was suffering from insomnia, nosebleeds while sleeping, constant nausea, headaches, heart palpitations, fatigue, loss of balance, and depression.
6. I called PG&E several times to request removal of the Smart Meter. They refused.
7. On November 7, 2011 I sent a certified legal notice to PG&E demanding the removal of their Smart Meter within 30 days. Non-compliance would require my replacement of the Smart Meter with an analog meter.
8. There was no response, so on 12/19/11 I had the meters switched. My symptoms all disappeared.

I declare under penalty of perjury that the foregoing is true and correct. I have personal knowledge of all facts set forth in this declaration and am competent to testify thereto if called upon to testify in a court of law.

This declaration was executed this 8th day of April, 2012 at Chico, California.

/s/ _____
Marla June Crites

Declaration of Nancy Hubert

I, Nancy Hubert, have personal knowledge of all facts set forth in this declaration and am competent to testify thereto if called upon to testify in a court of law. I hereby declare:

1. My name is Nancy Hubert, and I reside at...
2. My husband and I are utility customers of PG&E.
3. I personally experienced a smartmeter when PGE installed one on my neighbor's home approximately 40 ft away on May 7th, 2010.
4. I did not expect to notice anything from one gas smartmeter at that distance. However, I felt increasingly bad as the days wore on, with palpitations, irregular heartbeat, a feeling of overpressure in the chest, headaches, dizziness, weakness, emotional distress, anxiety and inner agitation, especially when I was on the side of our house nearest the meter. These symptoms were not and are not my norm.

When I would leave to go for a walk in another neighborhood or in open space, my headache, palpitations, etc. would go away and I would feel better overall, but symptoms would come back upon return home. I began to wonder if that one smartmeter could possibly be causing these unfamiliar and disturbing symptoms. Finally in desperation, on May 22, 2010, I put a metal wheelbarrow over the meter. My symptoms began to subside that day, and I was feeling pretty normal on May 23rd and 24th.

On May 24th, 2010, I was gone much of the day. Upon return home in the evening, I was feeling fine. I then worked for 2 hours in my office on the side of our house nearest the meter. All of the previously mentioned symptoms reappeared, and I was feeling terrible as I went to bed. The next morning I learned that my neighbors had removed the wheelbarrow on May 24th while I was gone, because PG&E had finally agreed to come out and deactivate the RF transmitter.

On May 25, 2010, a PG&E technician disabled the radio transmitter on the gas meter. All of my symptoms subsided.

5. On July 24, 2010, I went to visit my 92 year old father in Santa Rosa. I almost immediately began feeling weird symptoms including palpitations, irregular heartbeat and inner agitation, which I had never felt there before. I went outside, and sure enough, he had 2 smartmeters attached to his house which he was not aware of (one of them 12 feet from where I was sitting). I later noted his neighbors had been similarly installed.
6. I should mention that for years I have been constantly exposed to some level of RF, since I live within 800 feet of the Sebastopol downtown cell tower, and can

pick up 6 wifi signals in my home. I do not use a cellphone, cordless phones or wifi and I avoid places with cellphones and wireless devices.

None of these previous exposures prepared me for the onslaught of the smartmeter operating 24/7 next door, and I was very surprised at it's strength.

7. For these reasons I know that I cannot live or function in a neighborhood of smartmeters even if there are none on my own home.
8. I think it borders on criminal to charge anyone money to avoid the deleterious health effects of smartmeters on their homes or in their neighborhoods.

I declare under penalty of perjury under the laws of the State of California that the facts set forth above are true and correct to the best of my knowledge.

This declaration was executed this 2nd day of June, 2012 at Sebastopol, California.

/s/ _____
Nancy Hubert

Declaration of Patricia R. Noormand

I, Patricia R. Noormand, have personal knowledge of all facts set forth in this declaration and am competent to testify thereto if called upon to testify in a court of law. I hereby declare:

1. My name is Patricia R. Noormand, and I reside at...
2. I am a utility customer of Southern California Edison.
3. My SMART METER was installed on 3/20/12.
4. On 3/29/12 I noticed there was no power to my stove which I have NEVER had a problem with. I pulled the stove away from the wall, unplugged it, and plugged it in again. My stove did not turn on. I then plugged the stove into an adjacent socket. The stove turned on but then tripped the outlet breaker within seconds.
5. I contacted SCE. A repairman arrived the same day and said the power coming to the house is functioning properly, at the proper voltages. I was told by him and the SCE agent on the phone to file this claim:

Proof of Monetary Loss:

30" Frigidaire Stainless Steel Range purchased from Sears \$1,299.99 (I have original receipt)

6. I also requested that my SMART METER be switched out for my old meter.
7. To date, I have received one piece of correspondence stating that my claim is being investigating, but nothing has happened. No one has shown up at my home to investigate; I have not been reimbursed for loss and my SMART METER has not been removed.

I declare under penalty of perjury under the laws of the State of California that the facts set forth above are true and correct to the best of my knowledge.

This declaration was executed this 5th day of May, 2012 at Santa Barbara, California.

/s/ _____
Patricia R. Noormand

Declaration of Rhonda Hoefs

I, Rhonda Hoefs, have personal knowledge of all facts set forth in this declaration and am competent to testify thereto if called upon to testify in a court of law. I hereby declare

My name is Rhonda Hoefs and I reside at.... I am a utility customer along with Ron Lampi of PG&E.

It used to be that a person's home was their refuge. No more since the Smart Meters were installed.

1. We have had constant ringing in our ears, sometimes so loud that pressure is created, pushing the ear drums toward each other, like a vise to the head. No earplugs can eliminate this and it is very disorienting and stressful.
2. This has led to sleep disturbances , causing me to wake up hours before the desired time early in the morning. Once awake loud ringing greets you.
3. Which has led to stress, exhaustion, poor health, loss of job training and job opportunities
4. I've had tremendous hair loss as a result, and premature ageing, which is also a handicap when seeking work. Where I used to look 10 years younger than my age (all my life) now people are mistaking me for 10 years older. That is a gain of 20 years all in less than one year's time!
5. Digestion disturbance—Since being in the SmartMeter electrosmog I can no longer digest meat or even fish, one of the easiest proteins to digest. I will have to go out of my way to seek medical help without healthcare or the money to do so to try and correct this. Why should I have to spend extra money to correct something that was working just fine before? And I can't guarantee this can be corrected.
6. Including, my appetite has been strange. Normally robust, I have gone for long periods of apathetic appetite with no desire to shop for food or cook it. I have to force myself when previously I loved to cook (and eat). Included with this is a more frequent tendency to react to different foods or meals.
7. I have gotten sudden gushing nosebleeds since the SmartMeter systems have gone in. This is not normal for me.
8. Different healing products/medications that worked fine previously have been extremely compromised. At first I thought maybe something was wrong with the previously excellent products but since then I have discovered that this is one of the symptoms of electrical poisoning (radiation poisoning). As a result conditions

I had under control now control me.

9. Since the meters have gone in I have had undesirable weight gain, yet with atrophying of my body and poor muscle tone and skin tone. This despite the fact that I exercise religiously. Previously I have always been trim and a little exercise kept me in shape.
10. Since this exposure I have strange pains in my body. I am constantly dealing with pains in my leg and foot. Never had this before. Also one of my arms has been sore for over five months with no known injury or cause. I can't move it in a lot of ways. It is sore day and night. I have always been supple.
11. Since being in this environment my upper back has had skin eruptions of some kind that I could not control. I have never had this, nor do I have oily skin. This recently has seemed to ease but I believe the symptoms are going deeper (first hair, then skin, then digestion...). With exposure o a toxin first the body may react strongly, then some symptoms go "underground" while the damage goes deeper and more serious.
12. It is hard to focus, concentrate to get any mental work done. Setting goals is hard under these conditions, and leading a purposeful life.
13. Meditation is not an option. Can't be done now. A very easy thing for me normally. There is one bathtub that if you get low enough below the porcelain level you can meditate in a fashion, but this is no substitute for disciplined meditation.
14. Needless to say, with meters and relays everywhere added onto existing wireless and cell towers and fluorescents there are very few places I could be able to work a job. Every American has the right to work, and obviously, most of us need to be able to do so! There is no current remuneration for electrically poisoned people and even if there were— people have the right to be able to use their talents to contribute to society! This is blocking my right!
15. A strange back "injury" occurred to me doing absolutely nothing when the meters and support structures were going in around me. I wondered how this could happen when I wasn't lifting, bending, or exerting, nor had I had a fall or strain but when I reported this to the head of an organization who had been collecting health stories related to SmartMeters I was told that a huge amount of these injuries were occurring to people that was way out of proportion for even the ageing population. Not having health care this has seriously altered my life.
16. Eyesight has deteriorated significantly. It has been the same for 10 years plus years but since the SmartMeters are in I can't really read anything easily. I have recently bought glasses that are 3 times stronger than what I had but it's still

tiring. Normally I love to read and doing so is tied into my profession of writing and social work. But I am realizing I may have to give it up and that also means another hurdle in the way of working. It is completely abnormal for someone's eyesight to change overnight so radically. My eye are better when I can get away from this pollution.

17. Loss of time and energy that must be devoted to defending myself, my neighbors, my community. With the combined loss of time and health I have lost countless hours of my life that could go to working and other pursuits. I am not paid, let alone handsomely, like PG&E spokespeople, to monitor, educate, and interface with public and political figures. With my limited health this is even more of a burden. Why should I have to fight for the right to protect myself from a known health threat? The studies are all out there (see Commonwealth Club San Francisco EMF Summit).

The Kicker: These effects are coming from our neighbor's SmartMeters, all around us. The effects have gotten stronger as PG&E moved in and put in more meters and support structure. It was very evident. I lived in Felton a few years back and there was no problem here then. I also lived in a neighborhood in Aptos prior which had no meters and there were no problems there. Ditto, up in the mountains above Aptos. Without even having the meter on our own house we still get all these effects from the neighborhoods around us.

Other health problems have flared up significantly, that before were mild but now are chronic. But I think I have listed more problems than any person should have to endure just to have electrical measurements taken.

I declare under penalty of perjury under the laws of the State of California that the facts set forth above are true and correct to the best of my knowledge. This declaration was executed the eleventh of May, 2012 at Felton, California.

/s/ _____
Rhonda C. Hoefs

Declaration of Steven Golden

I, Steven Golden, have personal knowledge of all facts set forth in this declaration and am competent to testify thereto if called upon to testify in a court of law. I hereby declare:

My name is Steven Golden, and I reside at ...

1. I am a utility customer of SDG&E.
2. I have suffered health effects from the Smart Meters installed on my apartment building on September of 2011. I have suffered rapid heart beat, insomnia, muscle contractions, frozen joints and migraines.
3. I was able to replace only one of four Smart Meters on my building with analogue because SDG&E refused to replace the others with analogue meters unless my neighbors filed for the opt out and paid for it. The certified letter that SDG&E sent to me describing the opt out stated that the charge is for the entire address not just the one meter. They are not following their own guidelines.
4. I declare under penalty of perjury under the laws of the State of California that the facts set forth above are true and correct to the best of my knowledge. This declaration was executed this third day of May, 2012 in San Diego, CA.

/s/ _____
Steven Golden

Declaration of Sarah Jane Beard

I, Sarah Jane Beard, have personal knowledge of all facts set forth in this declaration and am competent to testify thereto if called upon to testify in a court of law.

I hereby declare:

1. My name is Sarah Jane Beard, and I reside at ...
2. I am a utility customer of San Diego Gas & Electric Company.
3. On April 15, 2011 the utility company, San Diego Gas & Electric deployed weapons of warfare SMART METERS in my neighborhood. I immediately heard a high pitched electric tone ringing in my ears. The tone is especially noticeable when using electric appliances, such as the Television or Computer and during quiet times in my back yard.
4. When the SMART METER installer arrived at my home, I refused installation on U.S. Constitutional grounds, citing my concerns about Health, Safety and Privacy issues. I believe it is my State and Federal Constitutional right to protect and defend my health, safety and privacy. The utility company came to my home two (2) more times in effort to convince me to allow installation of a SMART METER. The installer threatened me with litigation and denial of service but honored my refusal to allow installation of this Military weapon of warfare on my home.
5. In addition, around approximately April 15, 2011, I began suffering extreme fatigue. I then bought a \$450.00 HF 35C HF-Analyzer 800 MHz – 2500 MHz reads up to 1999uW/m2. I took my radiation meter to work and found that I was being exposed to over 2000 uW/m2 of microwave radiation all day long in approximately five second intervals. The radiation levels were stronger than my meter was able to read. This exposure made me quite exhausted. I would sleep all day after work and all day on the weekends. I felt like I needed a blood transfusion.
6. Later the radiation at my work stopped for unknown reasons and I in turn resumed to my normal functioning, health, well-being and energy levels.
7. If I am around cell towers and/or am exposed to microwave radiation while in public places I become extremely fatigued. Currently I do not walk Mission Viejo green belts because they are lined with cell towers emitting dangerous levels of radiation to all who walk near them. Please see <http://www.youtube.com/user/SarahParalegal> channel where I have documented some of my findings.
8. Currently I am very thankful that my home is currently free of a SMART METER

and high levels of microwave radiation where I have a place to recuperate from my exposures while in public places.

9. I find it disgusting that our Government is allowing this known carcinogen to radiate our children, elderly, the working men and women of our great country, causing them harm and a shortening all of our life spans.

I understand that this is a legally binding document. This declaration is made truthfully and to the best of my knowledge.

I declare under penalty of perjury that the foregoing is true and correct. I have personal knowledge of all facts set forth in this declaration and am competent to testify thereto if called upon to testify in a court of law.

This declaration was executed this April 4, 2012, Wednesday at Mission Viejo California



/s/

Sarah Jane Beard

Declaration of Tobie B. Cecil

I, Tobie B. Cecil, have personal knowledge of all facts set forth in this declaration and am competent to testify thereto if called upon to testify in a court of law. I hereby declare:

1. My name is Tobie B. Cecil, and I reside at ...
2. I am a utility customer of PG&E.
3. As a Property Manager and on behalf of a Property Owner, I have heard of and read of the dangers of these UL-unapproved Smart Meters. My concerns for the Owner, the residents and my own family are Smart Meter-related fires, privacy invasion, expensive rates, over-billing, hacking of personal information, wiring overloads, dirty electricity, explosions and health impacts on all.
4. Another concern of mine is the possibility of lawsuits against the Property Owner and myself due to the above-mentioned Smart Meter problems.
5. In addition, I think that the Smart Meter opt-out program is illegal and immoral and that Smart Meters should be banned since the ratepayers did not approve these meters.

I declare under penalty of perjury under the laws of the State of California that the facts set forth above are true and correct to the best of my knowledge. This declaration was executed this Nineteenth day of June, 2012, at Marina, California.

/s/ _____
Tobie B. Cecil

Declaration of William C. Beckham

I, William C. Beckham, have personal knowledge of all facts set forth in this declaration and am competent to testify thereto if called upon to testify in a court of law. I hereby declare:

1. My name is William C. Beckham, and I reside at ...
2. I am a utility customer of PG&E.
3. PG&E required me to allow them to install a SmartMeter on my residence. They demanded access to my property on a given date and I was not allowed to refuse them.
4. PG&E installed a SmartMeter on that date to both my electrical box and my gas meter.
5. Both of these meters are located on the wall opposite of our bedroom. The exact location is less than 2 feet from where our heads are located while sleeping.
6. Within weeks of the installation, my sleeping patterns began being disrupted as I would find myself waking up earlier and earlier as time passed.
7. I have found that in order to get a full nights sleep, I must take medication.
8. In the last year, my wife's sleeping patterns have also been affected as mine were.
9. When contacting PG&E about this situation, I was told to move to different location in our house to sleep or to move our bed to a different location.
10. The floorplan of our house does not allow me to move the furniture to comply as it will not fit in any other configuration.
11. I do not believe that it is justifiable to either force me to by a whole new bedroom set nor to have to pay PG&E a fee to have the old meter reinstalled.
12. If PG&E requires that homeowners have a SmartMeter attached to there house, they should be required to:
 - (a) Make sure that the location of the meter does not harm the inhabitants of the dwelling.

- (b) If the possibility exists for harm, install some kind of shielding to protect the homeowners.

I declare under penalty of perjury under the laws of the State of California that the facts set forth above are true and correct to the best of my knowledge. This declaration was executed this 3rd day of June, 2012 at Fresno, California.

/s/_____
William C. Beckham

Declaration of William George Riggan

I, William George Riggan, have personal knowledge of all facts set forth in this declaration and am competent to testify thereto if called upon to testify in a court of law.

I hereby declare:

1. My name is William George Riggan, and I reside at ...
2. I am a utility customer of Pacific Gas and Electric.
3. For the past three years I, and my wife, have lived with increasing anxiety over the prospect of having to place a SmartMeter on our home. We have made clear that we will not accept such a meter through:
 - multiple correspondences to PG&E
 - testimony before the Sebastopol City Council when PG&E representatives were present
 - assemblage for the Sebastopol City Council of educational materials on the dangers of low level RF and EMF non-ionizing radiation
 - letters to the CPUC
 - individual letters to members of the CPUC
 - REFUSAL signage on our front lawn for more than two years
 - REFUSAL declarations next to our analog electric and gas meters for three years
 - discovering and informing the EMF Safety Network that the Obama administration considered and rejected the plan for a nationwide mesh grid in late December of 1998, which PG&E must have known about and still has not revealed to the public.
 - a recent phone call to the 'opt-out' line to report that we demand to keep our analog meters without paying any surcharge, which we believe constitutes extortion and is still being treated by the CPUC as 'no action'.
4. We fear for the stability of our daughter's health. She is chemically sensitive, which means that her immune system is compromised. Believing, as many medical people do, that sensitivity is probably triggered by an event of overexposure, we do not want to risk another problem. This is not to say that the installation of SmartMeters on our home will definitively cause her to become electro-sensitive, but she may well be more susceptible to such an outcome than

most.

5. Given the omissions, half-truths and outright lies PG&E, the deceit that has characterized so much of the company's behavior of late, we have lived in a continual state of hyper-vigilance fearing that SmartMeters would be slapped on the house while we were away, despite all our efforts to prevent that happening.
6. The current source of discomfort, tension and anxiety is that we will have to pay now a surcharge for meters we have always had, which is nothing short of outrageous.
7. Long-term issue: frightening prospects of the unknown dimension of the certain health effects of the vast expansion of RF and EMF non-ionizing radiation throughout the environment. Cell phones are virtually ubiquitous, and given the news, for example, that there are now only four pay phones left in New York City (SF Chronicle) there are no easy alternatives. Not so with wireless computer networks (see Sonic's recent decision to return to wired) or with utility meters. Analog meters and meter readers comprise a safe system. A wireless mesh grid cannot ever be proven safe. Should PG&E decide to return to analog meters, I'd be happy to pay a substantial installation fee to retain my meters.

I declare under penalty of perjury and under the laws of the state of California that the facts set forth above are true and correct to the best of my knowledge. This declaration was executed this 13th day of May, 2012 at Sebastopol, California.

/s/ _____
William George Riggan

Declaration of Zachary Ryan Marks

I, Zachary Ryan Marks, have personal knowledge of all facts set forth in this declaration and am competent to testify thereto if called upon to testify in a court of law. I hereby declare:

1. My name is Zachary Marks, and I reside at ...
2. I am a utility customer of Pacific Gas and Electric (PG&E) and have chosen to opt out from having a Smart Meter on my home.
3. I am sensitive to EMF and have removed all wireless devices from my home to protect my health.
4. I do not have a Smart Meter on my home, but I am surrounded by Smart Meters on my neighbors homes.
5. Since Smart Meters were installed in my neighborhood I have experienced worsened anxiety, terrible headaches, and heart palpitations.
6. I think it is very unfair and wrong to charge me more money not to have a Smart Meter on my home.

I declare under penalty of perjury under the laws of the State of California that the facts set forth above are true and correct to the best of my knowledge. This declaration was executed this 25th day of May, 2012 in Lafayette, CA.

/s/ _____
Zachary Marks

Organizations - Russian Government; Electromagnetic Fields From Mobile
Phones: Health Effect On Children And Teenagers | Resolution Of Russian
National Committee On Nonionizing Radiation Protection | April 2011, Moscow

ELECTROMAGNETIC FIELDS FROM MOBILE PHONES: HEALTH EFFECT ON CHILDREN AND TEENAGERS



RESOLUTION OF RUSSIAN NATIONAL COMMITTEE ON NON- IONIZING RADIATION PROTECTION

April 2011, Moscow

This Resolution was approved by members of the Russian National Committee on Non-Ionizing Radiation Protection (RNCNIRP) at its Committee session on 3 March 2011. The Resolution evolved from scientific statements adopted by RNCNIRP in 2001, 2004, 2007, 2008 and 2009, taking into account contemporary views and actual scientific data. The Resolution represents a viewpoint of the professional scientific community and is meant for public dissemination, for the consumers of the mobile telecommunications services, as well as for the legislative and executive authorities who develop and implement health protection, environmental, communication, scientific and safety policies.

On behalf of members of RNCNIRP

Chairman, Professor Yury GRIGORIEV

Vice-Chairman, Professor Valentina NIKITINA

Vice-Chairman, Dr Oleg GRIGORIEV

RUSSIAN NATIONAL COMMITTEE ON NON-IONIZING RADIATION PROTECTION

Resolution:

ELECTROMAGNETIC FIELDS FROM MOBILE PHONES: HEALTH EFFECT ON CHILDREN AND TEENAGERS

The world-wide dissemination of mobile telecommunications has resulted in new sources of large-scale population exposure to radio-frequency (RF) electromagnetic fields (EMF) since 2000. At present, mobile phones dominate among the mobile communication services used by the population.

By the end of 2010, there were 219.3 million mobile phone SIM cards registered in Russian network operators [1]. The mobile phone penetration rate (expressed as the number of SIM cards registered per 100 people) has reached to about 150% in Russia, and exceeded 200% in the Moscow Region. According to ROSSTAT (Federal State Statistics Service of Russian Federation), there were about 15 million children and teenagers (ages from 5 to 19) living in Russia at the end of 2010 [2]. They all are presumed to be a target group for marketing for telecommunication service providers, mobile phone vendors and others.

Prevention childhood and juvenile diseases from exposure to EMF sources is of paramount social and economic importance. It is one of the bases for public health policy for the nation in the near and long-term future. This problem has been already recognized by the international community: in May 2011, the World Health Organization (WHO) will be organizing the Second International Conference: “Non-ionizing Radiation and Children’s Health” dedicated to health protection of children exposed to EMF sources of various frequency ranges. It is WHO’s opinion that a “child is more vulnerable to environmental factors” [3]. WHO considers that studies aimed at determining if there are risks to children’s health from exposure to EMF is a top priority.

Governments and public organizations of all technologically developed countries strive to protect children’s health by legislative and economic methods. They conduct special studies to assess effects from EMF [4]. EU documents suggest inadequacy of the current scientific base and the inconsistency between existing safety standards and popula-

tion exposure to EMF. Requirements for application of the precautionary principle have been formulated [5].

The Russian population is, to some extent, aware of the potential effects from RF EMF from mobile phones. According to a sociological survey conducted by the Russian Public Opinion Research Center (VCIOM) in 2010, “the percentage of those agreeing that use of a mobile phone may affect human health is 73%” [6].

Since 2001, the RNCNIRP has been studying the problem of possible health effects in children from RF EMF generated by mobile phones and is concerned about possible effects on children’s health [7, 8, 9]. This position of the Committee has been taken into account in the obligatory Sanitary Rule of the Russian Federation “Hygienic Requirements for Placement and Operation of Onshore Mobile Radio Devices” SanPiN 2.1.8/2.2.4.1190-03, p.6.9 [10].

RNCNIRP ASSESSMENT AND STATISTICAL DATA ON MORBIDITY OF CHILDREN AND TEENAGERS

In April 2008, the RNCNIRP reviewed the short-term and long-term effects of mobile phone use for children. In particular, it reviewed possible decrease of intellectual abilities and cognition together with possible increases in susceptibility to epileptic fits, “acquired dementia” and degeneration of cerebral nervous structures [11]. The results of clinical studies have shown that chronic exposure to RF EMF may lead to borderline psychosomatic disorders [12, 13, 14, 15, 16]. In 2010, a number of papers published in Russian and foreign peer-reviewed journals showed a response to RF EMF exposure from the immune system [17, 18].

Unfortunately, statistical data published in 2009 and 2010 by ROSSTAT and UNICEF show that, since 2000 there has been a steady growth in the incidence of childhood diseases identified by RNCNIRP as “possible diseases” from mobile phone use [19, 20]. Of particular concern is the morbidity increase among young people aged 15 to 19 years (it is very likely that most of them are mobile phone users for a long period of time). Compared to 2009, the number of CNS disorders among 15 to 17 year-old has grown by 85%, the number of individuals with epilepsy or epileptic syndrome has grown by 36%, the number of “mental retardation” cases has grown by 11%, and the number of blood

disorders and immune status disorders has grown by 82%. In group of children aged less than 14 years there was a 64% growth in the number of blood disorders and immune status disorders, and 58% growth in nervous disorders. The number of patients aged 15 to 17 years old having consultations and treatment due to CNS disorders has grown by 72%.

Because of this the RNCNIRP considers it important to conduct a scientific study to determine whether the growth in morbidity resulted from EMF exposure from mobile phone use or whether it was caused by other factors.

According to RNCNIRP, assessment of health effects from the mobile phone use by children should include the results of epidemiological studies, experimental studies on volunteers and the results of animal and cellular studies. The results of long-term studies conducted by a group of Swedish scientists have demonstrated a considerably increased risk of brain cancer among people who started to use mobile phones before 20 years old [21, 22, 23]. In children, the amount of so-called stem cells is larger than in adults and the stem cells were shown to be the most sensitive to RF EMF exposure, which may be one of the reasons why children are so susceptible to electromagnetic exposure [24]. The information on possible blood-brain barrier disturbances, cerebral bio-electric activity disturbances and structural disturbances of brain neurons from EMF exposure should also be taken into account for assessment of mobile phone safety [25, 26, 27].

Human brain and the nervous system tissues directly perceive EMF and react irrespective of its intensity, and in certain cases it depends on EMF modulation. This feature distinguishes EMF from all other environmental factors and complicates human health risk assessment for EMF exposure.

BASIC POSTULATES FOR DETERMINATION RISKS FOR CHILDREN AND TEENAGERS FROM EXPOSURE TO ELECTROMAGNETIC FIELDS

Analysis of scientific peer-reviewed national and international publications as well as analysis of actual population exposure to EMF have allowed the RNCNIRP to formulate 10 postulates - basic statements serving as a basis for assessment of risks to children's and teenager's health from exposure to EMF from all types of modern mobile

phones, irrespective of their communication standard. These statements are sufficient for the development and implementation of urgent supplementary precautionary measures.

1. For the first time in human evolution, the brain is daily exposed to modulated EMF at all developmental stages.
2. Absorption of EMF in a child's brain is greater than in adult phone users; larger brain areas including those responsible for intellectual development are exposed in a child's brain.
3. A child's brain is undergoing development and its intellectual functions are maturing thus it is more susceptible to environmental hazards than adult's brain.
4. Mobile phone is a source of EMF exposure that may result in health effects. The exposure to EMF from mobile phones is not controlled; the duration, time and frequency of mobile phone use are not limited. Mobile phone is an uncontrolled source of harmful exposure.
5. A child, due to its perception features, is unable to recognize the mobile phone as the source of harmful EMF exposure.
6. The existing basic standards for RF EMF had been established before the large-scale dissemination of the mobile radio-telecommunications and are not accounted for the current daily RF exposure of human brain in the near-zone of mobile phone antenna. At present, there are no scientific data on possible effects from chronic long-term exposure of human brain to EMF (especially, in children and adolescents).
7. The Sanitary Rule "Hygienic Requirements for Placement and Operation of Onshore Mobile Radio Devices" (SanPiN 2.1.8/2.2.4.1190-03) recommend limitation of mobile phone use by children and adolescents (p.6.9). However, mobile phone users are not informed about the necessity of reasonable limitation of its usage.
8. Declaration of a mobile phone safety included in the "User's Guide", as a rule, is based on recommendations of a public organization registered outside Russia, which has no legal and moral responsibility for possible health effects. These recommendations are out of date and no longer correspond to the current exposure situation to RF EMF from mobile phones.

9. The Specific Absorption Rate (SAR) used for declaration of a mobile phone safety, equal to 2 W/kg averaged over ten grams of brain tissue, in the opinion of the RNCNIRP, cannot be viewed as sufficiently scientifically grounded in this case, and its use does not guarantee protection of childhood and juvenile health.

10. Global changes in the electromagnetic background caused by the development of modern mobile technologies, is an evolutionary factor requiring adaptation of children and adolescents to this harmful environmental factor.

Thus, for the first time in the human history, children using mobile telecommunications along with the adult population are included into the health risk group due to the RF EMF exposure. A situation has emerged that cumulative EMF exposure of children may be comparable to adult exposure and may be equal to the levels of occupational exposure of workers. At the same time, the society, with all its administrative and social structures, remain in a "waiting" position.

PRIORITY MEASURES AIMED AT PROTECTION OF CHILDREN AND TEENAGERS

Taking into account the RNCNIRP position and the precautionary measures suggested by WHO, the Committee considers that urgent measures must be taken because of the inability of children to recognize the harm from the mobile phone use and that a mobile phone itself can be considered as an uncontrolled source of harmful exposure.

1. It is required that the information that a mobile phone is a source of RF EMF is clearly shown on the phone's body (or any other telecommunication device).
2. It is required that the "User's Guide" contains information that a mobile phone (personal wireless communication tool using electromagnetic communication method, etc.) is a source of harmful RF EMF exposure. Usage of a mobile phone by children and adolescents under 18 years old is not recommended by the Sanitary Rule SanPiN 2.1.8/2.2.4.1190-03, and mobile phone use requires implementation of precautionary measures in order to prevent health risks. Mobile phone use by pregnant women is not recommended in order to prevent risk for a fetus.
3. The easiest way to reduce RF EMF exposure is to move the mobile phone away from one's head during the phone call which may be achieved by using the hands-free sets

(protection by distance). Shortening the call duration is another way to reduce the exposure (protection by time).

4. The RNCNIRP considers it is reasonable to develop mobile phones with reduced EMF exposure (with hands-free sets, included limitation functions, such as limitation of the number of daily phone calls, possibility of forced limitation of phone call duration, etc.).

5. It is required to include courses on mobile phones use and issues concerning EMF exposure in the educational program in schools.

6. It is reasonable to set limits on mobile telecommunications use by children and adolescents, including ban on all types of advertisement of mobile telecommunications for children (teenagers) and with their participation.

7. The RNCNIRP is ready to assist the mass-media in their awareness-raising work and educational activities in the area of EMF and, in particular, to provide information about the newest research of the impact of EMF on human health and the measures to curb the negative impact of this physical agent.

8. Better safety criteria for children and teenagers are required in the nearest term. Features of the developing organism should be taken into account, as well as the significance of bioelectric processes for human life and activities, present and future conditions of EMF, prospects of technological and technical development should be addressed in a document of legal status.

9. Development of a funded national program for studying possible health effects from chronic EMF exposure of the developing brain is necessary.

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Committee formed of highly qualified scientists and specialists. Now it comprises 36 persons. RNCNIRP members represent the leading research centers of the Ministry of Health of Russia, Russian Academy of Sciences and Academy of Medical Sciences, Ministry of Defence, as well as non-governmental organizations.

The RNCNIRP is a union of scientists conducting research in the biological effects of non-ionizing radiation in fields of radiobiology, health, physics and other disciplines. Each session of the Committee is meeting professionals the opportunity to comprehensively discuss almost any issue, maintain and enhance academic and personal contacts.

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